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ABSTRACT

Education is a process of adapting to change, and the rate of change is especially rapid in science today. This curriculum in human biology is an alternative to the New York State courses in general and Regents biology, and it has been designed to focus on change from the standpoint of the urban student. It is designed to provide students with experiences which encourage the development of critical thinking and problem solving skills. The laboratory experiments are intended to involve students in both the evaluation and interpretation of data, as well as in the design of their own experiments. The document is divided into nine broad units, with each unit divided into a series of sub-topics. The major topics covered are: (1) Why Do We Study Biology? (2) Of What Are Living Things Made? (3) How Do Our Cells Get the Materials They Need? (4) How Do Our Bodies Carry Out Their Activities? (5) Why Do We Behave the Way We Do? (6) How Can We Prevent and Control Disease? (7) How Do Humans Reproduce? (8) What Determines What We Are? and (9) How Have Living Things Changed? Each page in the guide is divided into four columns: (1) performance objectives; (2) basic understandings; (3) suggested procedures; and (4) enrichment activities. (TW)

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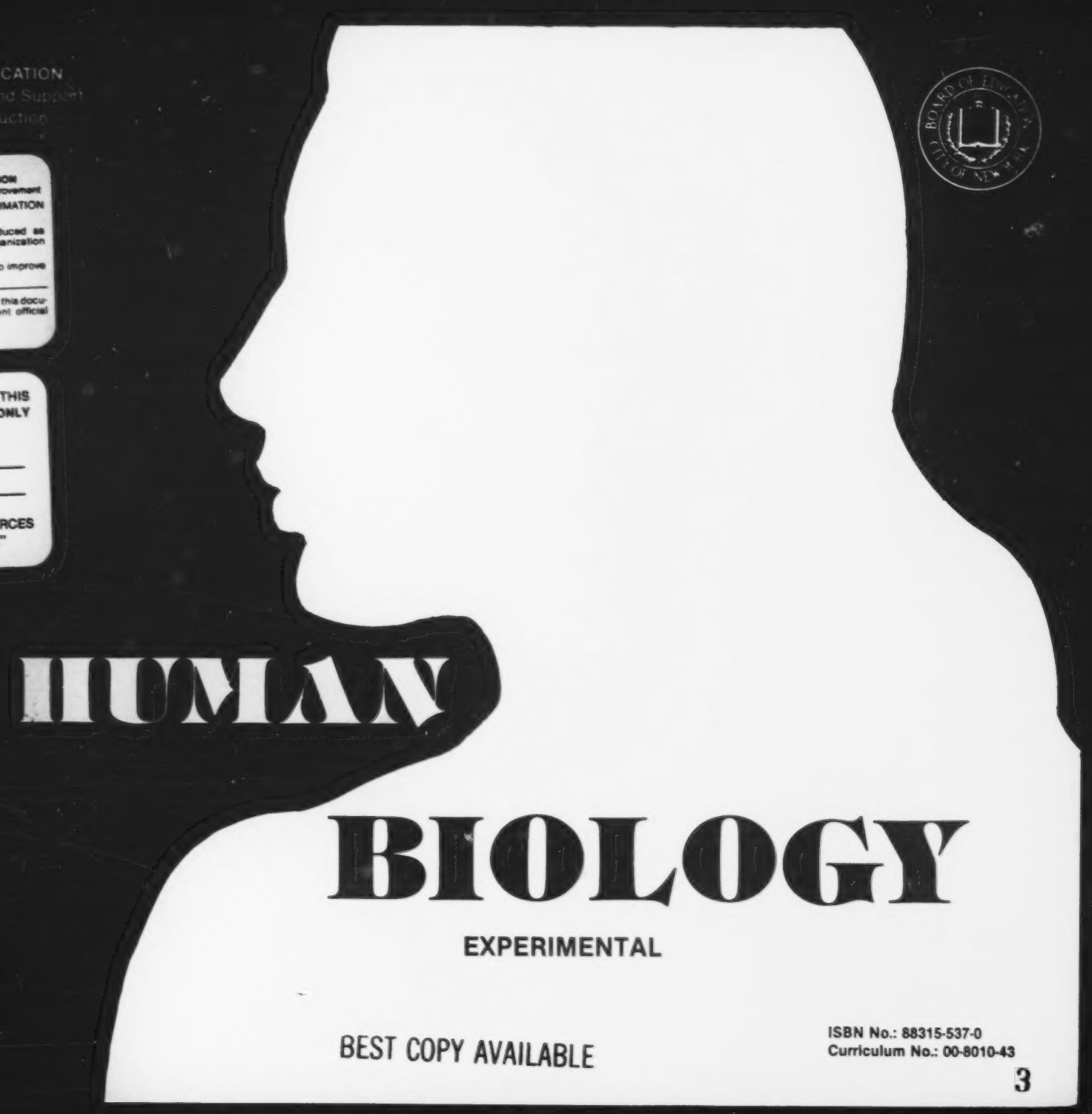

HUMAN BIOLOGY

EXPERIMENTAL

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FOREWORD

Education is a process of adaptation to change, and nowhere is the rate of change so great as in today's world of science. In the medical field alone, thousands of concepts and techniques which were unknown a decade ago are now in common practice.

This curriculum in *Human Biology* is an alternative to the New York State courses of study, *Regents Biology* and *General Biology*. In keeping with our philosophy to "meet the needs of every child," this course has been designed for the urban student who may have little or no interest in modern biological theory but would benefit from a course that was more human-oriented.

The course in *Human Biology* provides the student with experiences which encourage the development of skills needed for critical thinking and problem solving as well as the basic skills of recall and comprehension. Laboratory problems involve students in both the evalutation and interpretation of data as well as the design of their own experiments.

Human Biology is organized into nine broad units with each unit divided into a series of conceptual sub-topics. Some of these sub-topics may require more than one teaching period, depending upon the needs of individual groups of students who come to the classroom with diverse levels of basic skills. However, all students will be given experiences to improve these skills. *Human Biology* places special emphasis on motivating students and exposing them to situations and conditions which require analytical thinking — such as laboratory experiments and challenging reading and writing assignments.

This new course of study has been reviewed by the Science Bureau of the New York State Education Department, and has been approved, subject to future evaluation, for Group III credit. To help with this evaluation, we request that all teachers who teach *Human Biology* complete the questionnaire, pp. 113 and 114, and return it to the Science Unit as soon as they finish teaching the course. A final edition of *Human Biology* will be prepared based both on this teacher feedback, and upon student performance on citywide examinations prepared especially for this course of study.

The ultimate success of *Human Biology* will be determined by the numbers of students who are sufficiently stimulated by the program to enroll in science courses beyond the two-year requirement for the New York City high school diploma. It is our hope that as a result of student exposure to this course, enrollments in science electives will soar.

Charlotte Frank

Charlotte Frank
Executive Director
Division of Curriculum and Instruction

ACKNOWLEDGMENTS

The curriculum bulletin, *Human Biology* is a project of the Division of Curriculum Development and Support, Morris Freedman, Director, under the auspices of the Division of Curriculum and Instruction, Charlotte Frank, Executive Director.

Anthony Galitsis, Director of Science, organized and supervised the project.

In March, 1983, a group of high school science assistant principals were asked to meet with Dr. Galitsis for the express purpose of analyzing the newly revised New York State course of study, *Regents Biology*, and comparing it to the New York State syllabus *General Biology*. The members of the group were: Marilyn Dente, Assistant Principal/Supervision (Science), Long Island City High School; Harold Haiken, Teacher of Biology, George Washington High School; Harold Visner, Assistant Principal/Supervision (Science), Hillcrest High School; Eugene McCoy, Assistant Principal/Supervision (Science), Martin Luther King High School; Saul Reine, Assistant Principal/Supervision (Science), Tilden High School; Geoffrey Schwartz, Assistant Principal/Supervision (Science), Bay Ridge High School; and Wilma Alexander, Assistant Principal/Supervision (Science), Bushwick High School.

It was unanimously agreed by the committee members that the two State courses of study were essentially similar in all respects except for depth of coverage, with the Regents course giving a much greater emphasis to the theoretical aspects of biological principles than the *General Biology* course of study. This reflected the opinions previously expressed by the majority of science supervisors in New York City. The committee agreed that neither State course served the interests of a large portion of New York City's urban population. A course in *Human Biology*, with a focus on the student as a human organism, would, the committee felt, be intrinsically more motivating than one laced with biochemistry and photosynthesis.

The committee further agreed that the New York City course of study developed in 1967, *General Biology,* was closer to what was needed than either of the two New York State biology courses.

A thorough revision of the 1967 syllabus, as prescribed by the committee members, was planned, and a writing team consisting of Ms. Dente (chair) and Robert Werner, Assistant Principal/Supervision (Science), George Washington High School, was appointed in April to begin the revision process.

Work continued throughout the summer of 1983 during which time Ms. Dente (chair), assisted by Messrs. Haiken and Visner, wrote the final product. The manuscript was reviewed by Professor Harold McKenna of City College of the City University of New York, and many of his suggestions are incorporated in this final document.

Many of the ideas and methodologies present in the 1967 syllabus were kept intact in the revision process, although they have been integrated with the new concepts introduced by the present writers in keeping with the theme of *Human Biology.* The original 1967 *General Biology* was written by a team which was chaired by Mr. Visner and included Ms. Dente as well as Monroe Cravits, Teacher of Biology, Lafayette HS* and Melvin Krieger, Teacher of Biology, Prospect Heights HS.*

The Curriculum Editorial and Production Unit, Alaire Mitchell, Unit Head, prepared the project for publication. Under the supervision of Maureen Maguire, Production Coordinator, the type was composed by Billye Timbes, the mechanicals were done by Conrad Nunnally, artwork was done by Kathleen Asvestas, and the cover was designed by John Gampert.

*Titles in effect at the time of writing.

How to Use This Bulletin

This teacher's guide is divided into four columns:

- Column One lists the specific performance objectives for each sub-topic. The performance objectives indicate the behavior the teacher should use to determine if the students are achieving the goals of each sub-topic. They also provide the basis for measuring each student's achievement by means of appropriately designed pencil and paper tests.
- Column Two contains the basic understandings for which the student will be held responsible. In writing the understandings, the authors have attempted to put them in a form suitable for placement on the chalkboard so that students can record them in their notebooks.
- Column Three, entitled "Suggested Procedures," contains a logical development of the topic. It also contains motivating activities and pivotal questions that may be incorporated into lesson plans to develop the understandings in Column Two.
- Column Four contains additional activities that can enrich the understandings. However, their use is discretionary and depends on the time available and the interests of the students.

In the present course, methodology is of paramount importance. To attempt to teach this course in the usual traditional pattern is to doom it to failure from the very start. Ample opportunity will be found to use many of the worthwhile techniques employed by alert biology teachers. The wise and sympathetic teacher will:

1. use a variety of procedures in each lesson
2. avoid lectures or sustained "question-answer" discussion
3. incorporate frequent laboratory experiences
4. provide practice in reading and writing skills in each lesson using materials adapted to the levels of the students' basic skills
5. develop and reinforce the new vocabulary used in each lesson

6. use demonstrations by students and the teacher whenever possible
7. utilize the creative abilities of the students in drawing, poster work, and model making
8. use the chalkboard for writing about, diagramming, or reviewing material
9. encourage a greater degree of pupil participation in planning classroom work
10. encourage investigations at home with inexpensive equipment to foster the spirit of inquiry and to add to the interests of the students
11. incorporate the daily experiences of the students in lessons
12. include career information during lessons
13. use daily, varied homework assignments to reinforce learning and to improve basic skills development

Remember, success breeds effort which breeds future success. If students realize that they can pass tests, class activities will be more productive. Pencil and paper tests may be modified to give them the opportunity to pass written tests successfully. The following are recommended:

1. word association tests
2. tests based on extracting information from a paragraph
3. simple tests of the essay type
4. tests requiring students to label diagrams with supplied terms
5. tests requiring students to obtain information supplied by diagrams to complete open-ended sentences
6. word definition tests

In short, tests can be of many types and vary in length from five minutes to full-period examinations. Because many students have difficulty dealing with an examination that covers several weeks' work, it is preferable to have a few short tests divided into sub-topics rather than one long examination. The types of test questions utilized should be directly correlated with the indicated performance objectives for each sub-topic.

Additionally, the use of the *Mastery Learning Techniques* of Dr. Benjamin Bloom has proved very successful in several schools, and their use is recommended.

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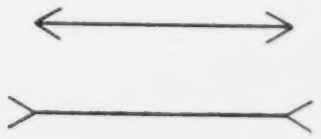
Unit 1: *Why Do We Study Biology?*

Topic A: *What activities do living things carry on that keep them alive?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify the functions that are carried out by living things. • recognize the life function described in a specific situation. • explain the purpose of life functions. • recognize that reproduction is necessary for the species, not for the individual.	Living things carry on the following life functions: **a)** getting food **b)** respiring **c)** moving **d)** getting rid of wastes **e)** responding to changes **f)** making substances **g)** reproducing **h)** growing **i)** transporting Life functions are directed at keeping the body in balance. Although reproducing is a life function, it is only necessary for the species, not for the individual member.	Suggested motivation: Burn 3 by 5 inch pieces of paper. Point out that as you feed the flame more paper the flame grows. The flame uses oxygen and gives off carbon dioxide. If the burning paper is divided, two flames result. Wind will cause a flame to move or spread. Compare and contrast the observations made of the flame with those made of a live animal brought to class to explore why the flame is not living but the animal is. Emphasize that distinguishing between living and non-living things may be a problem but scientists have defined "life" as a set of functions.	Point out that people, too, must carry out these life functions. Discuss each life function as it contributes to homeostasis and indicate that reproduction is necessary for the species, but not for the individual. Contrast the growth of a crystal by accretion (addition of materials to the outside) with the life function of assimilation (growth from within). Have students obtain pictures to make collages of living and nonliving things. Have students attempt to define the word "life" without using the word "living" in forming the definition. Use one or more of the following to have students observe life functions: land snail aquatic snail hamster goldfish earthworm laboratory rat laboratory mouse guinea pig turtle Have students observe male and female guppies with their fry. Students are to use their observations as a basis for writing a definition of "life."

Topic B: *How do biologists study living things?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify the means by which biologists study living things • recognize the necessity for the use of tools by biologists because of the limitations of human senses and the need for accuracy. • identify tools that may be used by a biologist. • distinguish between an electron microscope and a compound microscope.	Biologists study living things by observation and experimentation. Biologists use tools to help them make more accurate and better observations and to conduct experiments. Tools used by biologists include: a) light microscopes b) electron microscopes c) x-ray and fluoroscopes d) radioactive isotopes and Geiger counters e) computers f) electronic instrumentation g) field binoculars	Suggested motivation: Have students remove a single strand of hair from their scalps. Instruct the students to describe the structure of the strand of hair. Elicit that the descriptions are inadequate and that the use of a magnifier would improve their abilities to observe. Use a Geiger counter and a radioactive source to show that we cannot always detect with our body senses that which is present. Elicit from the students other tools that may be used to study the human body. Diagram 1-1 	Have a representative of a medical technology firm speak to the class about their machines and career opportunities. Laboratory Experience: a) Supply each student with diagrams of two lines of equal length as shown: ***diag. 1-1 The student should indicate which line he/she thinks is longer. The visual observations should be checked by measuring each line with a ruler. b) Have each student place one hand in a bucket of hot water (approximately 120° F) and the other hand in a bucket of ice water. Plunge both hands into a bucket of tepid water (approximately 75° F) Direct the student to describe what he/she perceives. c) Present each student with a tall, narrow container and a short wide container holding equal amounts of water. Instruct the student to state which container holds the most water and which holds the least. Have the student measure the amount of water in each container using a graduated cylinder. The purpose of these lab experiments is to demonstrate that biologists need tools and instruments because of the limitations of human senses and a need for accuracy.

Topic C: *How do scientists usually solve problems?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify and order the steps of a scientific method. • identify a statement as being either a problem, an observation, or an hypothesis. • identify the control in a given experiment. • select a possible hypothesis for a stated problem.	Scientific method may consist of the following: **a)** stating a definite problem **b)** making observations and collecting data **c)** making an hypothesis (educated guess) that accounts for the observation and could be a possible solution to the problem **d)** testing the hypothesis by means of controlled experiments The control part of an experiment compares what would happen if the thing you are testing is not present.	Suggested motivation: Prepare ten Petri dishes with nutrient agar inoculated with *Bacillus subtilis* or any other non-pathogenic bacteria not resistant to penicillin. Place a square of penicillin-solution-saturated filter paper in the center. Incubate for 48 hours. Distribute the Petri dishes. Caution students about opening dishes. (Dishes should be taped before distribution.) Elicit from the class that the cloudy areas are a result of the growth of bacteria. List observations made by the class and elicit the problem: "Why is there a clear area around the filter paper?" Ask the class to make several guesses that would explain what they observed. Elicit from the class experiments that can be set up to test their guesses. Elicit the importance of a control. Relate the above to Fleming's discovery of penicillin.	Students may carry out their experiments to test their guesses in the laboratory. The historical development of the idea of spontaneous generation (Redi's experiment) is an alternate way of teaching a scientific method. Establish that, as a result of carrying out life functions, cells produce certain poisonous wastes such as CO_2 and hydrogen peroxide. CO_2 is excreted by means of respiring. Ask the class to make an hypothesis as to why the cells do not die from hydrogen peroxide poisoning. Have the students design an experiment to test the hypothesis. *Note to teacher: An enzyme called catalase breaks down hydrogen peroxide into O_2 and H_2O. Sources of catalase include fresh liver, potatoes, and yeast.* Elicit how a control can be set up. The above may be done as either a demonstration or a laboratory experience.

Topic D: *How can we know the difference between superstition and fact?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • select a possible related cause for a given event. • distinguish between superstition and events that illustrate cause and effect. • recognize that predictions can only be made if the event occurs every time under the same conditions.	Events take place only when there are related causes. An event can be predicted only if it has occurred every time under the same set of conditions in the past.	Suggested motivation: Distribute "Checklist for Superstitions" in the Appendix and have the class complete the activity. Elicit that the items in the checklist, which do not occur every time, are superstitions because they cannot be used to predict future events.	Students submit a list of other beliefs and analyze for cause and effect.

Unit 2: *Of What Are Living Things Made?*

Topic A: *What do living things look like under a microscope?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • state that all living things are made of cells. • identify the common parts of all cells (nucleus, cytoplasm, cell membrane). • distinguish between an animal cell and a plant cell. • relate the parts of a microscope to their specific functions. • use a microscope to examine a cell under low and high power.	There are living things smaller than can be seen with the naked eye. Living things are made of cells. Cells have parts in common: a) nucleus b) cytoplasm c) cell membrane d) mitochondria Green plant cells also have cell walls and chloroplasts. The work done by a cell depends on the functioning of its parts.	Demonstrate how to use a microscope. Discuss care and proper handling of a microscope. Teach the rules for focusing and demonstrate the preparation of a wet mount. It is suggested that the following three aspects be stressed: a) use of the microscope b) cellular structure of multicellular organisms (onion skin, cheek epithelium) c) observation of microscopic organisms	Laboratory lessons providing the opportunity to observe the cellular structure of: frog's blood and Elodea. Laboratory lessons providing the opportunity to observe microscopic organisms: mixed protozoa cultures, bean infusion, hay infusion, plankton samples, and *Daphnia* Use Spencer or Bausch & Lomb wall charts of the microscope; also 8½-by-11-inch printed sheets obtainable free from above companies.

Topic B: *Why do we have different types of cells in our bodies?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • **recognize variety in cell types (muscle, epithelial, bone, nerve).** • **define a tissue.** • **explain that different tissues have different jobs.** • **name four kinds of tissues that make up the human body.** • **match structures and functions of the tissue cells.**	Similar cells doing a similar job make up a tissue. The different tissues have different jobs to do. The structure of the cell is related to the job done by the tissue. The body is made up of different kinds of tissues.	Suggested motivation: Have students examine different types of human body cells using microviewers. Briefly discuss their observations to establish that each kind of cell has a certain size, shape, and structure. Use construction paper cutouts of cells and put the cells together to form a "tissue." Compare this with how cheek epithelial cells form the lining of the students' cheeks. Laboratory experience: Preparation of cheek epithelial cell slide. Establish that each tissue has a specific function. For example, demonstrate a lamb shank showing connective tissue around a muscle. Remove some muscle fibers and prepare a demonstration slide. Show bone and bone marrow. Expose a nerve. Obtain chicken feet and cut into the skin, exposing tendons. Groups of pupils pull various tendons to see effects. Pull on tendon. Discuss "pulled" tendon. Locate ligaments. Discuss why sprains heal so slowly. Locate cartilage.	Bring to class models of various types of tissue cells and relate each to its function in allowing the body to work properly. Teacher microscope demonstration of: frog muscle; frog skin (epidermis side up and epidermis side down on one slide to permit comparison).

Topic C: *What does the inside of an animal look like?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • put in order of complexity: cells, tissues, organs, organ systems, and organisms. • define an organ. • state that organs are grouped into organ systems. • explain that each organ system is primarily concerned with carrying out one of the life activities • name the six organ systems of an animal.	Tissues are formed into organs. Organs are grouped into organ systems. Each organ system is primarily concerned with carrying out one of the life activities.	Suggested motivation: Perform a frog dissection, preferably as a pupil laboratory lesson. Pupils are to observe and study: a) alimentary canal, liver and pancreas, and gall bladder b) peristalsis by stroking stomach and intestines c) contents of stomach and intestines to see digested food d) both lungs, by inserting tapered glass tube into glottis and blowing e) heart beating f) testes or ovaries and ducts g) kidney and its blood supply h) connective tissues holding organs together i) lens inside the eyeball; extract the lens. Place lens on newsprint to see how it magnifies letters. j) muscle bundles. Strip skin off hind legs. Find spinal nerves and stimulate or pinch them with forceps to force muscle spasms. Establish nerve-muscle connection. k) tendons. Cut off a foot and pull on some tendons. Note bending of toes. l) bony skeleton; also ball and socket joint. k) brain, if time allows.	Establish the names of the organ systems into which the organs observed are grouped. Use charts and models of frog dissection to elicit general function of each organ system. Do not go into detail. Film: "Frog Anatomy" covers the whole process of dissection of a frog. Each step is clearly recorded by the close-up camera and described completely by the narrator. *Indiana University film.*

Topic D: *What does the inside of a person look like?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • state the general plan of the human body. • indicate that the diaphragm separates the chest cavity from the abdominal cavity. • name the organs located in the chest cavity. • name the organs contained in the abdominal cavity.	The structure of the human body has many similarities to the structure of other animals. The general body plan of the human is a chest cavity and an abdominal cavity separated by the diaphragm. The heart, lungs, liver, and gall bladder are located in the chest cavity. The abdominal cavity contains the stomach, intestines, pancreas, urinary bladder, kidneys, and reproductive organs.	Suggested motivation: How many students have had an operation? Where do you have a scar? Why was the body opened at that particular point?	Dissect a human mannikin. Compare and contrast with the frog's anatomy. Use various models and charts to show the organs of the body. Have the class construct a felt board mannikin. Show the film: "Man: The Incredible Machine." (color, 28 minutes, *National Geographic)* Show the film: "The Human Body — Systems," *Coronet Instructional Films*

Unit 3: How Do Our Cells Get the Materials They Need?

Topic A: *Why do we eat?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • indicate two reasons for eating. • define a nutrient. • list the six nutrient groups. • identify the body's use of each nutrient.	Eating is a source of pleasure for some people. Eating is necessary for survival. Food contains chemicals that your body needs. These chemicals are called nutrients. The nutrients are: **a)** carbohydrates (starches and sugars) **b)** proteins **c)** fats and oils **d)** vitamins **e)** minerals **f)** water Carbohydrates and fats are the main sources of energy for the living cell. Proteins, minerals, fats and oils are the sources of the chemicals needed by the cell to grow and repair itself. Proteins, vitamins, and minerals are the sources of chemicals needed to regulate body activities. Water is used to dissolve and transport materials.	Suggested motivation: Bring to class a typical student meal from the school cafeteria and also a selection of candy, cookies, ice cream, and orange drink usually eaten by many students. Ask the class which of the above lunches they usually select. Why do some pupils prefer candy and cookies to the meal prepared by the dietician? Why doesn't the dietician select a meal consisting of candy and cookies?	Burn some typical foods, such as butter cookies or peanuts, to show that food contains energy. Show pictures of animals and humans that have been kept on deficiency diets. Discuss the significance of protein deficiency in kwashiorkor as related to nutrient deficiences in food available in some countries. The body needs 1 gm. of protein for every 2 pounds of ideal body weight. Try to burn a lump of sugar. Repeat after dipping the sugar into cigarette ash. Elicit from the students that certain chemical reactions require an additional substance which the biologists call an enzyme.* The enzyme speeds up the reaction, but is not used up in the process. Relate the role of the cigarette ash to the role of Vitamin B in the release of energy from food. Establish that many vitamins act as co-enzymes. **Please note: Contrary to popular belief, the ash is not a catalyst in this reaction, but an active participant.*

Topic B: *How does our diet affect our health?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • distinguish between a healthful and a nonhealthful diet. • recognize that a deficiency disease will result from lack of a specific nutrient. • recognize that there are essential amino acids that the body cannot make and, therefore, must be obtained from food. • contrast animal sources and plant sources with respect to complete protein. • recognize that excessive amounts of certain nutrients can cause illness. • recognize that certain foods can interfere with medicines.	A healthful diet must provide the proper balance of all nutrients. Diets lacking proper nutrition will result in deficiency disease. There are essential amino acids the human body cannot make. Animal sources of protein provide all essential amino acids. These are known as complete protein sources. No one vegetable contains complete protein; however, combinations of specific vegetables may provide complete protein. Excessive amounts of certain nutrients do cause illness. Foods containing Vitamin C can interfere with erythromycin antibiotics. Foods containing calcium interfere with tetracycline antibiotics.	Suggested motivation: Show the class pictures of people suffering from diet deficiences. Refer to advertisements heralding various fad diet procedures and ask "Could the people showing these deficiencies be helped by the advertised diets?" Elicit from the resulting discussion that a proper diet provides all the nutrients required by our cells in amounts specified for each individual. If one chose to become a vegetarian, what things would one have to be careful about in selecting foods? Emphasize the need for including the essential amino acids which the human body cannot make, since no one vegetable contains all essential amino acids. Discuss how one may obtain complete protein by combining various vegetable foods such as rice and beans. Have the students read the labels on several vitamin bottles and note that the amount of vitamin D rarely exceeds 500 units. Elicit that it has been shown that excess amounts of vitamin D lead to calcium deposits, particularly in the kidneys.	Compare the nutritional labels on the various brands of similar foods. Laboratory experience: Perform the test for vitamin C using indophenol. Test orange juice, apple juice, orange drink, and various commercial fruit punches. Demonstrate various nutrition tests using a variety of foods. Test a student lunch for the presence of various nutrients. Plan a menu for a healthful diet for one day. Discuss various deficiency diseases such as pellagra, beriberi, scurvy, anemias, rickets, night blindness. Assign reading lessons using pamphlets obtainable from the U.S. Government Printing Office, Washington, D.C. 20402, or from various industrial sources.

Topic C: *How do calories affect our health?*

Performance Objectives

The student should be able to:

- identify the calorie as the unit for measuring energy in food.
- select factors that determine caloric requirements.
- recognize the relationship between body weight and caloric intake.
- identify the components of a balanced diet.
- differentiate between a balanced and a nonbalanced diet.
- recognize that medical consultation is necessary when dieting.
- recognize the dangers inherent in fad and crash diets.

Understandings

The energy in food is measured in Calories, or large calories.

The number of calories needed depends upon age, sex, body size, and mental and physical activity.

The intake of more calories than the body requires will cause overweight.

A balanced diet consists of the proper amounts of all nutrients and the proper number of calories.

Any diet should be a balanced diet.

A doctor should be consulted whenever dieting.

Crash diets do not work because they cannot be maintained and do not supply adequate nutrition.

Suggested Procedures

Suggested motivation:
Using the following information, calculate the number of calories needed by one pupil in the class.

Daily Calories Needed

Kind of Activity	Calories Needed per Pound per Hour
Resting, sleeping	0.30
Reading, writing, eating	0.70
Light chores and study, fast typing, slow walking or dancing, classwork	1.00
Concentrated study, bicycling, recreational games	2.00
Hard labor, competition games such as football, basketball, swimming	3.50

Why is the result of the calculation for one pupil not valid for all the pupils in the class?

What would be the results of taking in more or less calories than needed?

Why is it dangerous to consider only calories in dieting?

Why is a baked potato a better source of calories than a lump of sugar of equal caloric value?

Enrichment

Demonstrate how the caloric value of food is measured by means of a calorimeter.

Invite the school dietician to the classroom to explain the school lunch program and the job junctions of a dietician.

Have the students check their daily food intake by means of a calorie chart to see if they are obtaining the proper number of calories.

Ask the students to bring in literature concerning the popular diets and evaluate.

Obtain free pamphlets concerning calorie content of foods in classroom quantities for free distribution to the class.

Discuss anorexia nervosa.

Topic D: *How should we select and prepare our foods to maintain health?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● identify whole grains and vegetables as excellent sources of vitamins, minerals, and roughage. ● recognize that removing seed coats from grains removes vitamins and minerals. ● distinguish between enriched and fortified foods. ● interpret food labels to determine nutritional value and the presence of preservatives. ● identify three preservatives or additives which may be harmful. ● recognize the advantages or disadvantages of various methods of food preparation.	Whole grain cereals (containing the outer seed coat) and fresh vegetables are rich in vitamins, minerals, and roughage. White flour and rice have had this seed coat removed and therefore have less vitamins and minerals. Enriched flour and cereals have had some vitamins and minerals replaced. The wrapper or label of a product should be consulted for information concerning the nutritional value and the presence of preservatives. Some food preservatives or additives may be harmful. Over-cooking reduces the vitamin and mineral content in foods. There seems to be a relationship between diets rich in saturated fats and salt and circulatory diseases. Steaming, broiling, and baking are more healthful methods of food preparation than boiling and frying.	Suggested motivation: Boil string beans and test the water in the pot for Vitamin C (use a control). Elicit other ways by which vitamins and minerals may be lost from foods. Have students examine the wrappers from breads and cereals. Elicit that some of the minerals and vitamins lost in milling have been replaced by enrichment. Some foods are fortified with extra vitamins and minerals. Discuss the value of roughage in the diet. Discuss: **a)** MSG Syndrome. Elicit that this additive is now prohibited in baby foods and that it is possible to order Chinese foods without MSG. **b)** relationship between nitrites (used as a preservative in hot dogs and cold cuts) and cancer. **c)** the roles of excess salt and saturated fats in contributing to circulatory diseases. **d)** the Food and Drug Administration's restriction on the addition of sugar to baby foods. Elicit that excess sugar in the diet may contribute to dental caries formation and the "addiction" of children to sweets. **e)** excess use of sugar substitutes may cause illness.	Why is eating raw vegetables and fruits desirable? Bring in advertisements of various food products and evaluate claims. How do the claims in these advertisements compare with what you have learned about food? Discuss the use of food substitutes such as: **a)** saccharin **b)** aspartame **c)** fructose **d)** potassium chloride **e)** xylitol **f)** sorbitol

Discuss the differences in steaming, broiling, boiling, baking, and frying as methods of food preparation. Elicit that frying in fats:

a) involves the use of high temperatures which destroy some vitamins.

b) dissolves out (leaches out) fat soluble vitamins.

c) adds fat to the diet which may result in additional saturated fats and empty calories.

Topic E: *How can we stretch our food dollar?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize the economy of buying foods in season. • compare value per unit cost in packaged foods taking into account nutritional value. • compare the nutritional value of different foods (cuts of meat, fresh and frozen) compared to cost.	Seasonal variation in availability of foods very often affects the price. Most fruit juices have more nutritional value than fruit drinks. The intelligent consumer considers quality as well as price. The intelligent consumer considers price per unit weight because of possible deceptive packaging. The intelligent consumer considers the nutritional value per unit weight.	Suggested motivation: Use indophenol to show the difference in Vitamin C content in fruit juices and fruit drinks. Compare relative cost per unit of Vitamin C content. Use ads from newspapers for different months to compare the cost of a given food. Establish that seasonal variation in availability often affects price. Compare cost per unit of nutritional value for cerals by bringing in various brands of the same products. Question the amount of food we eat. The average American overeats. Much of overeating is "junk food." Stress that better eating habits give better nutrition and save money. Americans spend millions of dollars a year on diet programs. Elicit that the need is caused by spending millions of dollars on overeating. Emphasize that money is wasted both ways.	Reading lesson using appropriate issues of *Consumer Report* or *Consumer Bulletin.* Compare wrappers of oleomargine and other foods of the same type. Analyze food advertisements in the daily newspapers. Consider the various means of grading and naming cuts of meat. Read selections from *The Jungle* by Upton Sinclair. Compare prices of fresh foods and prepackaged foods. Discuss value of food supplements (protein, vitamins and minerals) to insure proper nutrition.

Unit 4: *How Do Our Bodies Carry Out Their Activities?*

Topic A: *How is food prepared for use by the cell?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that the human body is built on a "tube within a tube" plan. • define digestion. • recognize the necessity for digestion. • contrast mechanical and chemical digestion. • identify the role of digestive enzymes. • identify the parts of the digestive system. • relate the roles of the accessory organs to the process of digestion.	The human body is built on a "tube within a tube" plan. Food must be broken down chemically into small molecules that can leave the digestive tube and enter the blood. A digestive enzyme breaks down large food molecules into small food molecules. Food must be broken down mechanically into smaller pieces so that digestive enzymes can be more effective (chewing). The digestive tube is divided into the mouth, esophagus, stomach, small intestine, large intestine, and anus. The liver, gall bladder, pancreas, and salivary glands are accessory organs which produce and store chemicals that aid in digestion.	Suggested motivation: Relate the following anecdote to the students: A baby swallowed a marble and a grape. When the mother changed the diaper later on, she found the marble and the pits of the grape. Ask the students to suggest hypotheses to explain the mother's findings. Elicit that: **a)** the human body is built on a "tube within a tube" plan. **b)** only small molecules can leave the digestive tube and enter the blood. **c)** the molecules that leave the digestive tube must pass through a cell membrane. **d)** the cell membrane has tiny pores too small to be seen with an ordinary microscope. Demonstrate the digestion of starch by adding amylase to a 1% starch suspension to which idodine has been previously added. Have the students explain why the color changed after the suspension had been maintained at body temperature for a few minutes. Discuss the role of digestive enzymes such as amylase. Discuss the role of the teeth in helping digestive enzymes to be more effective. Contrast mechanical digestion with chemical digestion.	Demonstrate digestion by having students chew but not swallow a piece of green banana. Students should sense a sweet taste that develops after the banana is chewed and mixed with the digestive enzyme in saliva. Prepare three test tubes as follows: **a)** Add ½ inch cube of boiled egg white and artificial gastric juice (Protease + 0.01% HCl). **b)** Add ½ inch cube of boiled egg white which has been cut up into small pieces and artificial gastric juice. **c)** Add ½ inch cube of boiled egg white and water. **d)** Incubate all three tubes at body temperature for 24 hours. Have the class observe and explain the results in each of the test tubes. Describe Dr. Beaumont's experiment using a "window" in St. Martin's stomach. Use models and charts to show the digestive system. Point out the appendix and discuss appendicitis.

Trace the path of food through the alimentary canal describing the functions of the various parts and the accessory organs (liver, pancreas, gall bladder, and salivary glands).

Laboratory experience:
In order to illustrate the concept of a "tube within a tube" structure, pupils should dissect an earthworm.

Describe Heimlich's maneuver for choking victims.

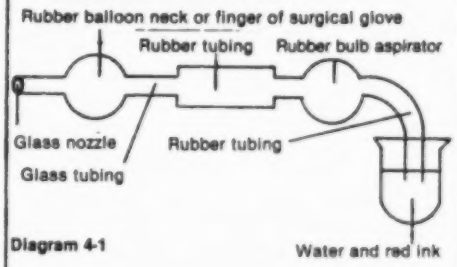
Topic B: *How do digested foods get into the blood?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recall that molecules are in constant motion. • identify diffusion as the process by which materials move between the blood and cells. • predict the direction in which molecules will diffuse. • recognize the danger in the habitual use of laxatives. • identify the role of roughage.	Molecules are in constant motion. Molecules move from an area in which they are closely packed (high concentration) to an area in which they are loosely packed (low concentration). This movement is called diffusion. The habitual use of laxatives may be dangerous. Roughage serves the function of maintaining proper movement of materials along the intestine.	Suggested motivation: Show that ammonium hydroxide turns phenolphthalein red. Prepare a test tube of phenolphthalein and fasten a semi-permeable membrane across the mouth. Invert the test tube over an open bottle of ammonium hydroxide. Elicit that ammonia molecules are diffusing across the membrane and changing the color of the solution. Why does the ammonia and not the phenolphthalein diffuse across the membrane? (The size of molecules is the factor.) Relate to the diffusion of digested foods across the villus membrane in the small intestine. Discuss the dangers of the habitual use of laxatives and the role of roughage in preventing constipation.	Conduct a molasses diffusion demonstration. Construct a screen with a wooden frame. Bounce various sizes of pebbles on the screen to show that smaller pebbles go through. Prepare two tubes of sausage casing, each knotted at one end. Place a 1% starch suspension in one tube and a glucose solution in the other tube. Tie off the open ends and place the tubes in a beaker of water. After several minutes have passed, test the water in the beaker for starch and for glucose. Discuss with the students the reasons for their observations.

Topic C: *How does the blood reach every cell in the body?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify blood as the transporter of materials. • list the four main parts of the circulatory system. • identify the function of each major part of the circulatory system. • identify the role of lymph. • trace the flow of blood through the body. • label a diagram of the heart.	The blood carries materials throughout the body. Our blood circulatory system consists of the heart, arteries, veins, and capillaries. The heart pumps the blood by creating blood pressure. Arteries carry blood away from the heart while veins carry blood to the heart. Diffusion of materials into and out of the blood occurs in thin-walled capillaries that connect arteries and veins. Lymph carries materials between the capillaries and the cells. There are two separate circulatory systems going through the human heart—one pumps blood to the lungs, the other pumps blood to the body.	Suggested motivation: Discuss the "blue-baby" and elicit that the cells are not receiving enough oxygen. Trace the pathway of the blood through the heart. Point out the separation in the heart between the pulmonary and the systemic systems and trace the flow of blood to the body organs. Observe goldfish tail circulation. Note pulsation in arterioles. Note the thin walls of the capillaries. (The blood cells pass through singly.) Elicit that diffusion of materials occurs only through the walls of the capillaries. Elaborate by means of diagrams that capillaries do not come in contact with every single cell. Point out there is a fluid called lymph that carries material between capillaries and cells.	Observe the beating heart in daphnia. Observe circulation in the web of a frog foot. A microprojector may be used. Observe circulation in the earthworm and note pulsations in the aortic arches ("hearts") and in the dorsal blood vessel. Dissection of an animal heart (secured from a local butcher). Discuss the role of valves in the veins. Relate this to varicose veins. Assign reading lessons using materials obtainable from the New York Heart Association. Discuss why "black and blue" marks sometimes form when students bruise themselves. Discuss the formation of blisters. Show the film, "Hemo the Magnificent." Discuss the film "Fantastic Voyage."

Topic D: *How does our circulatory system break down?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • relate blood pressure to the pumping of the heart and the elasticity of arteries. • select one cause of high blood pressure. • recognize how arteries may lose elasticity • define "stroke." • identify the part of the circulatory system that supplies food and oxygen to the heart. • identify the cause of the common heart attack. • recognize that the CPR technique is an emergency measure for aiding heart attact victims and must be started within three to four minutes to prevent brain damage.	The pumping of the heart together with the elasticity of arteries produces the blood pressure that keeps the blood flowing. High blood pressure (hypertension) may be caused by a "hardening of the arteries," a loss of elasticity caused by buildup of cholesterol inside the blood vessel. A stroke is the result of a rupturing of an artery in the brain. The heart is composed of cells which receive their food and oxygen by means of coronary circulation. Clogging of a blood vessel may be caused either by a blood clot or a buildup of cholesterol. A common type of heart attack is the result of a clogging of one of the vessels that supplies these heart muscle cells. Cardiopulmonary resuscitation is a technique that can be used by ordinary people to deliver immediate aid to a victim of a heart attack. It is important that a victim of heart attack receive CPR within three to four minutes to prevent extensive brain damage.	Suggested motivation: Bring in a sphygmomanometer and elicit that it is used for taking blood pressure. Ask "Where can you get your blood pressure checked?" Ask the question, "Why is it important to check blood pressure?" Have students take their pulses and discuss what they are feeling. Use the apparatus shown in diagram 4-1 to elicit how blood pressure is produced (by the action of the heart and the elasticity of the arteries).  Diagram 4-1 Replace the rubber balloon neck with a piece of plastic tubing with the balloon neck slipped over it. Elicit that a coating on the inside of an artery may cause a loss of elasticity and thus raise the blood pressure, causing the heart to work harder. Cholesterol, a fatty substance present in some food and in our blood, may cause this hardening of the artery.	Discuss the relationship between the excessive use of salt, caffeine, and smoking to hypertension. Discuss the fact that only about 10% of the people with hypertension are being treated because in most patients hypertension does not show easily recognizable symptoms. Discuss the role of exercise in connection with the health of the circulatory system. Take students' blood pressure. Show cardiac muscle tissue by means of a chart, film, or photomicrograph. Laboratory experience: Use stethoscopes to listen to the heart. Determine the effect of exercise on heartbeat. Explain what is meant by a "heart murmur" and discuss valve replacement surgery. Show pictures and discuss modern surgical procedures for replacing or correcting clogged sections of blood vessels. Discuss the role of anticoagulants in the treatment of thrombosis.

Elicit that high blood pressure may cause a blood vessel in the brain to rupture, thus causing a stroke. If an arterial wall is weakened, the high blood pressure will cause the wall to balloon (an aneurysm).

Suggested motivation:

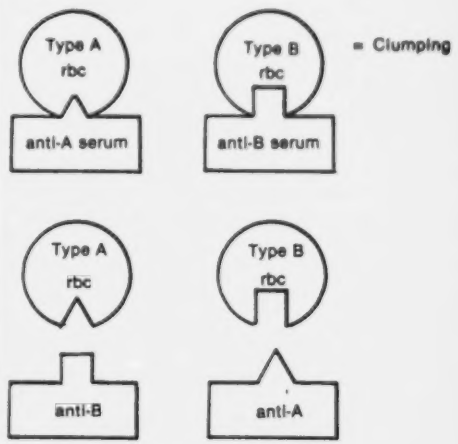
Explain to the students that many communities, schools, and places of business are encouraging their people to take CPR courses. Elicit the reasons, including the need for rapid attention because of the probability of rapid tissue damage in the heart and the brain resulting from a heart attack.

Show how heart cells receive their food and oxygen by means of coronary circulation. The blood vessels of this circulatory system may become clogged because of a blood clot or constricted by a buildup of cholesterol.

Show an electrocardiogram tape. Point out atrial and ventricular contractions.

Have a CPR instructor demonstrate the techniques for the class.

Topic E: *How is our blood similar yet different?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify the components of blood. • relate each blood component to its function. • recognize that although all blood looks alike there are chemical differences in the red blood cells and in the plasma. • list the four major blood types. • recognize the importance of the Rh factor in childbirth. • apply the principle that in a blood transfusion the blood types of the donor and receiver must be compatible.	Blood consists of red blood cells, white blood cells, blood platelets, and a liquid portion called plasma. The red blood cell carries oxygen by means of an iron-containing compound called hemoglobin. Some white blood cells fight germs and others produce antibodies. The platelets help in blood clotting. The plasma (90% water) carries digested foods, wastes, and antibodies. Although all blood looks alike, there are chemical differences in the red blood cells and in the plasma. One way of grouping blood depends upon the chemical makeup of the red blood cell membrane. The four major blood types are A, AB, B, and O. Another way of grouping blood is according to the Rh factor. Rh negative mothers may produce antibodies that harm Rh positive fetuses. In a blood transfusion, the blood of the donor must be typed and matched with that of the receiver.	Suggested motivation: Laboratory experience having students examine the parts of blood using microviewers. Elicit that blood consists of red blood cells, white blood cells, platelets, and a liquid portion called plasma. Why is blood red? Elicit that most of the cells are red blood cells that get their color from an iron-containing compound called hemoglobin. Discuss the function of hemoglobin. Why is a raised white blood cell count an indication that there is an infection? What is the role of blood cells in the formation of a blood clot? Stress the role of the platelet. What kinds of materials are picked up and delivered by the liquid part of the blood? If everyone's blood consists of the same parts, why does the blood bank type the blood of every donor? Elicit that there are various types of red blood cells according to the chemical makeup of the cell membrane (antigens).	Using wooden blocks or colored construction paper, make red blood cells and plasma proteins as diagrammed below: Diagram 4-2  Use these models to establish compatible blood types for transfusion purposes. Discuss the advantage of plasma transfusion. Point out that plasma cannot always be used. Discuss the value of blood banks. Why might it be possible to receive a pint of blood from a stranger who lives in another part of the world and not from a close relative?

Demonstrate blood typing using prepared blood typing kits.

Elicit that a person with type A cells has anti-B plasma; a person with type B cells has anti-A plasma; a person with type O red blood cells has anti-A and anti-B plasma; a person with type AB cells has neither anti-A nor anti-B substances in the plasma.

Discuss Rh factor as related to childbirth and the use of Rho-GAM in dealing with this problem.

Why is it dangerous to transfuse the wrong blood type into a person?

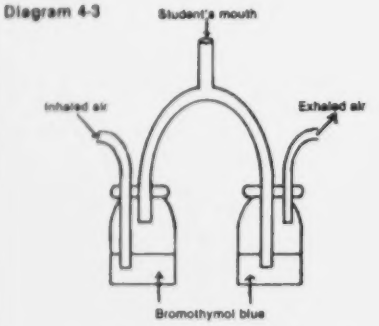
Demonstrate the measurement of blood clotting time using a capillary tube. Relate this to the rate of healing.

Invite a speaker or obtain a film from the Greater New York Blood Bank.

Discuss the possible process of changing the blood type of donated blood.

Conduct a reading lesson using pamphlets available from the Greater New York Blood Bank.

Topic F: *Why do we breathe?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • define breathing • recognize the role of the rib cage and diaphragm in the mechanics of breathing. • contrast the amount of oxygen, carbon dioxide, and water vapor in inhaled and exhaled air. • identify the air sacs as the site of gas exchange. • identify that our body uses oxygen to release energy from food, forming carbon dioxide and water vapor as waste products. • realize that respiration takes place in body cells.	Breathing is the method by which we take air into and release air from our lungs. The action of the rib cage and diaphragm changes the size of the chest cavity. This forces air into and out of the lungs. The air we exhale has less oxygen but more carbon dioxide and water vapor than the air we inhale. Oxygen is exchanged for carbon dioxide and water vapor in the air sacs. Our body uses oxygen to release energy from food. Carbon dioxide and water vapor are formed as wastes. This process takes place in the cells and is called respiration.	Suggested motivation: Have a muscular, well-developed youngster demonstrate breathing. Compare the student's activity with the bell-jar model showing lung-diaphragm action. Briefly elicit the mechanics of breathing. Direct one student to exhale through a straw into limewater or bromothymol blue while a second student pumps air into a different container of the same solution. Elicit the differences between inhaled and exhaled air. Establish that the exchange of gases takes place in the air sacs (alveoli) of the lungs. Discuss the use of oxygen by the body to release energy from food. Elicit that carbon dioxide and water are formed as wastes. (Demonstrate the presence of water vapor by exhaling on a glass surface.)	Bring in articles on air pollution. Why should you never leave a car motor running in a closed garage? Discuss the necessity of oxygen supply in space travel. Consider the advantages and disadvantages of air conditioning. Use a respirometer. Diagram 4-3  Direct student to inhale and exhale through his mouth slowly and constantly through the tube. Discuss the heart-lung machine. Discuss the latest methods of artificial respiration.

Topic G: *Why must our bodies get rid of wastes?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify that wastes are a result of the chemical activities of the body. • identify the five wastes of the body. • relate each waste to the life process which gave rise to it. • identify how the body keeps its chemical substances in balance. • recognize why the body must excrete waste. • list three organs of excretion. • identify the wastes of each organ of excretion. • recognize the similarity between sweat and urine. • relate the evaporation of sweat to a lowering of body temperature.	Wastes are formed as the result of the chemical activities of the body. Some of the wastes that are formed are: a) *carbon dioxide* and *water* — result from respiration b) *nitrogenous wastes* — result from the breakdown of proteins c) *salts* — result from the breakdown of other nutrients d) *materials* and *roughage* not absorbed from the digestive tube are eliminated as solid waste e) excess *heat* must also be gotten rid of in order to maintain a constant body temperature. The body keeps the amounts of chemical substances constant by getting rid of these wastes. A serious upset in the balance of chemical substances may result in death. The lungs, kidneys, and skin are organs of excretion: a) the lungs excrete carbon dioxide and water b) the kidneys excrete urine that contains nitrogenous wastes, salt, and water c) the skin excretes sweat that contains nitrogenous wastes, salt, and water	Suggested motivation: Entertainers are no longer allowed to cover their entire bodies with paint. Why could this practice result in death? (Inability to sweat out wastes.) Elict the common waste products. From which activities are they formed? Oxygen is the "garbage man." It combines with waste carbon and hydrogen to form CO_2 and H_2O. Consider how the body is equipped to get rid of these wastes. How do we maintain a normal body temperature? Why is a doctor concerned if you have a high fever? Indicate that high temperature inhibits enzyme activity. How can high body temperatures be reduced? Elicit that the lungs, kidneys, and skin are organs of excretion. List the wastes they excrete. What would happen if an organ of excretion failed to function? Elicit that wastes act as poisons.	Laboratory Experience: Take oral temperature reading before and after physical activities. *Caution: Cleanse thermometers thoroughly in alcohol and rinse thoroughly with water before using. Do not permit pupils with physical disabilities to perform exercises.* Apply water to a pupil's skin. Then apply alcohol to a pupil's skin. Which substance would be more effective in reducing body temperature? Why? (Evaporation removes heat.) Bring in newspaper and magazine articles concerning the use of the kidney machine and transplants in saving lives. Show perspiration from skin by having a student touch the chalkboard with his fingers. Laboratory exercise: Test urine sample for sugar. How is the kidney constructed to perform its function? (Nephron filtration) Use charts, models, or beef kidney secured from butcher.

Sweat and urine are similar.

Evaporation of sweat lowers the body temperature.

Establish that the kidney acts as a filter to remove nitrogenous wastes and excess water and salt from the blood. Using a chart of the excretory system, show how these wastes pass from the kidney to the urinary bladder and are excreted as urine.

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Topic H: *What are the functions of our skeletal system?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● identify the four functions of the skeletal system. ● define a "joint." ● recognize that bones are held together by ligaments. ● recognize that bone is living tissue capable of growth and repair. ● distinguish between a dislocation and a fracture. ● recognize arthritis as a disease of bone joints.	The skeletal system provides the body with: a) support b) protection c) levers for movement d) sites for blood cell production Joints are the points at which bones come together. Bones are held together by ligaments. Bone is living tissue and can grow and repair itself. A dislocation occurs when the bones at a joint move out of place. Arthritis is a disease that occurs at bone joints.	Suggested motivation: If one counted all the bones in an adult human skeleton, one would find 206 bones. Elicit the functions of the skeletal system. Bring in a model of a human skeleton and ask class to determine if the skeleton is a male or female. Discuss the differences in bone structure (e.g., hip bone). Bring in articles about athletes' bone or joint injuries. Use a skeleton to demonstrate that bones come together at joints. Compare and contrast different types of joints. Show x-rays of dislocations and types of fractures. Compare and contrast. Why can a broken bone heal? Obtain a long bone longitudinally cut and discuss the function of bone marrow. Use a reading lesson from pamphlets from The Arthritis Foundation to establish that arthritis is a disease that occurs at bone joints.	Turn a chicken bone to "rubber" by soaking in vinegar. Discuss the differences between the baby skeleton and the adult skeleton. Show photomicrographs of bone cells. Discuss why older people are more likely to experience fractures than younger people. Discuss the problem of bone decalcification as related to space travel.

Topic I: *How do we move?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that movement is produced through an interaction of muscle and bone. • identify that muscles contract to produce movement. • recognize that muscles work in pairs. • differentiate between tendons and ligaments. • identify the three types of muscle tissue by function and structure. • apply the principle that muscles must maintain tone to function effectively. • differentiate among sprain, tendonitis, cramp, and strain. • evaluate the desirability of warming up versus not warming up before strenuous exercise.	Movement is produced through an interaction of muscle and bone. Muscles shorten (contract) when moving bones. Because muscles can only shorten, two different muscles together move a bone back and forth. (Muscles work in pairs.) The muscle attachment to the moving bone is called the insertion and the attachment to the nonmoving bone is called the origin. Muscles are attached to bones by tendons. There are three types of muscle tissue (skeletal, smooth, and cardiac). Skeletal muscle is under voluntary control. Smooth and cardiac muscles are involuntary. Muscles must maintain "tone" to function effectively. A sprain is the result of injured ligaments or tendons. Tendonitis is the swelling of a tendon. A cramp is a sudden contraction that continues.	Suggested motivation: Have students place their hands palms down on their inner forearms just below the elbow joints. Direct students to make fists. Elicit that the muscle in the forearm contracts when the hand moves. Use a skeleton and balloons to demonstrate that movement is the interaction of muscle and bone. Introduce the terms "insertion" and "origin." Identify a tendon. Have students locate the muscles that permit them to extend and to withdraw their forearms by grasping their upper arms with their hands. Elicit that muscles work in antagonistic pairs. Laboratory experience: Have students dissect chicken wings. Identify muscles, bones, tendons, and ligaments. Suggested motivation: Display a picture of a "body builder" flexing muscles. Indicate that the muscles being displayed represent only one type of muscle used by the body to produce movement. Elicit that this is voluntary movement. Discuss other types of movement (involuntary) employed by the body. Examples:	Bring in articles relating to muscle injuries in athletes. Discuss muscular dystrophy or myasthenia gravis using pamphlets or films from appropriate foundations. Discuss the development and maintenance of good posture. Discuss hernias and ruptures.

A strain is muscle soreness following long activity.

"Warming up" before strenuous exercise can reduce the risk of injury to muscles, ligaments, and tendons.

a) muscles moving food along the digestive tract
b) muscles contracting the urinary bladder
c) muscles contracting the uterus during childbirth
d) muscles contracting the chambers of the heart to pump blood
e) muscles constricting arteries.

Identify the three different types of muscle tissue by using microviewers to examine skeletal, smooth, and cardiac muscle cells. Students should draw diagrams of the three types of muscle tissue.

Discuss the advisability of maintaining muscle tone through exercise and proper nutrition. Elicit that muscles not in "tone" do not function effectively and are more easily injured.

Discuss muscle cramps, sprains, strains, tendonitis, and muscle fatigue. Stress that "warming up" before strenuous exercise can reduce the risk of injury to muscles, ligaments, and tendons.

Unit 5: *Why Do We Behave the Way We Do?*

Topic A: *How do we react to change?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • differentiate between a stimulus and a response. • define "behavior." • recognize the function of a nerve cell • differentiate between a sensory nerve cell and a motor nerve cell. • identify the functions of a receptor. • recognize that a muscle or a gland produces a response. • define a reflex. • identify the components in a diagram of a reflex arc.	A stimulus is a change in the environment. A response is an adjustment made to a change in the environment. Behavior is everything we *do* or *say* which can be observed. The nerve cell is a specialized cell which carries messages (nerve impulses). A receptor is a specialized cell that receives a stimulus and changes it to a nerve impulse. A sensory nerve cell takes the impulse from the receptor to the control center (spinal cord or brain). A motor nerve cell carries an impulse from the control center to a muscle or a gland. A muscle or a gland produces a response. A reflex is an immediate response to a stimulus done without thinking.	Suggested motivation: Toss cotton or paper balls at a student holding a glass plate in front of his/her face. Can he/she prevent the eye blink? After pulling the shades, turn the lights on and off and ask the students to observe the changes in the pupils of their neighbors' eyes. As a result of this, establish that a stimulus is a change in the environment and the response is an adjustment made to this change. How does the information about the change get to the control center? Develop a diagram of a simple reflex arc. Develop the idea that receptor organs such as the eye, the ear, and special sensory cells change a stimulus into a nerve impulse which is carried to the control center by the sensory nerve cell. Motor nerve cells carry nerve impulses back to the muscles serving the eye which carry out the response. Establish that this is a reflex act. Discuss the survival value of blinking, pulling away from hot objects, and similar reflexes.	Demonstrate the knee jerk reflex. Use a normal frog to demonstrate reflex actions — jumping, eye blink, swimming, scratch reflex (with weak acetic acid), and balancing. Describe the responses of a frog with its brain destroyed and a frog with only its spinal cord destroyed. Compare behavior in all cases. Summarize the observations on the chalkboard. Place a frog in a battery jar. Observe that the frog readjusts and assumes its original position each time the jar is rotated. Place a snail in a test tube and wait until the snail climbs upward. Invert the test tube. The snail will change direction and climb upward. Use the filmstrips, "Know Thyself," made by *Sunburst Communications.*

Topic B: *How do we get new behavior patterns?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that the reflexes with which we are born are usually protective. • identify specific described behaviors as reflexes, conditioned reflexes, voluntary acts, or habits. • recognize that behavior patterns other than reflexes are learned. • differentiate between an inborn reflex and a conditioned reflex. • differentiate between a voluntary act and a habit.	We are born with certain reflexes which are usually protective. Other patterns of behavior are learned and include: **a)** conditioned reflexes **b)** voluntary acts **c)** habits In a conditioned reflex a new stimulus or response has replaced the original one in the reflex. A voluntary act is an act requiring thinking. A habit is a common type of behavior resulting from doing an action over and over again until it is done automatically.	Suggested motivation: Distribute washed and sterilized rubber bands to all students. Have the students look at the rubber bands and describe their responses. (Students should not salivate.) Ask the students to chew the rubber bands and record their responses. Develop the concept that the salivation stimulated by chewing the rubber band is an inborn reflex similar to blinking, grasping, crying, and knee jerking. Pass out small pieces of blotting paper and have students touch them to their tongues. Next the teacher displays, describes, and eats a slice of lemon. Students now touch the other end of blotting paper to their tongues and look for the difference (paper should be wetter). Elicit that they have learned to substitute the sight of the lemon for the original stimulus of the chewing of the food in the mouth. This is an example of learning by way of conditioning. More often a conditioned reflex has a new response substituted for the original response, for example: toilet training, behavior patterns in class.	Demonstrate the knee jerk or eye blink as an inborn reflex. Have students copy a dictated passage without dotting the *i* or crossing the *t*. Tally errors. Direct students to draw a diagonal line in their books at the command "Write." At the same time, tap on the desk. After 15 to 20 commands, tap only. Observe behavior. Discuss. Discuss Pavlov's experiment in conditioning dogs. Trace steps involved in: **a)** learning to swim **b)** learning to dance **c)** learning to type **d)** learning to walk Trace steps in habit formation: **a)** role of desire to do so **b)** repetition with no exceptions **c)** satisfaction (role of praise) List habits useful in daily life: **a)** habits concerned with personal living **b)** safety habits **c)** study habits Have students sign their names with right hands and left hands. Compare signatures.

How would you explain the fact that many drivers make a left turn for a number of days after a sign prohibiting a left turn has been posted? Develop from this situation that many aspects of driving are habits and point out the value of habit formation.

Discuss how to break a habit.

Discuss learning to be a switch hitter in baseball.

Evaluate the effectiveness of various antismoking programs.

Topic C: *How do we form prejudices?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● recognize that fears develop after birth. ● recognize that many fears have no scientific basis. ● discriminate between rational and irrational fears. ● recognize that fears are learned. ● define "prejudice." ● identify prejudicial statements.	Fears develop after birth. Many fears are unjustified because they have no scientific basis (*e.g.*, fear of sleeping in a dark room). Fears are learned. Prejudice is a learned attitude about something or somebody that cannot be supported by scientific testing.	Suggested motivation: Little children love soft fluffy stuffed animals. However, they may develop a fear of them after an encounter with a live animal, for example, a barking dog. Explain this new behavior pattern. Elicit that the "fear" behavior pattern has been conditioned by the introduction of an unpleasant experience. Indicate that this single unpleasant experience has been extended to cover cases where it is not justified. Ask students to consider some of their own fears and attempt to discover the origins. Bring to class a can of fried grasshoppers and indicate their nutritional value. Invite students to eat them. Establish that their food habits are the result of conditioning. Discuss with the students how their attitudes towards people develop. Elicit that attitudes are learned. Develop the concept that making generalizations from a single observation or experience is unscientific and therefore the actions of a single individual cannot be used as the basis for a prejudice against an entire group.	Establish that most of the students would not eat tomatoes from plants grown in a cemetery. Discuss the basis for this decision. Explore how the media can influence prejudicial attitudes.

Topic D: *How do we learn something new?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • list at least four methods by which humans learn. • differentiate among the five methods of learning. • identify a specific learning activity as imprinting, repetition, trial and error, memory, or reasoning.	We learn by imprinting — patterning our behavior from first impressions. We learn by repetition. We learn by trial and error — repeating efforts until the solution is found. We learn by memory — building up a reservoir of facts. We learn by reasoning — drawing conclusions from past experiences.	Suggested motivation: A newborn monkey was immediately removed from its mother in the dark. It was placed in a cage containing a "cloth mother" with a round blanket face. After several months, it was replaced by a "cloth mother" with a monkey face. This was rejected by the infant monkey. Even the real mother was rejected. Elicit that this is one of the first ways that we learn. (Show the film *Mother Love*, available from OLMT.) Hand out letter *L* puzzle (Appendix). Have students record the time for three trials for the same puzzle. Hand a student several keys and ask him/her to open a lock. Elicit that the selection is determined partly by reasoning and partly by trial and error. Point out that reasoning cuts down on the length of time required by trial and error.	Mimeograph a simple maze. Have students do three trials. Time each trial. Discuss the work of Konrad Lorenz with his goslings. Discuss the factors influencing learning such as: a) perceptual ability b) motivation c) state of health d) study habits

Topic E: *How should we study?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize the seven factors which contribute to successful study.	Studying takes place best when: **a)** there is a desire. **b)** the "big picture" is understood. **c)** each individual idea is clearly understood. **d)** there are no distractions or interferences. **e)** it is done regularly rather than by cramming. **f)** the student is not physically fatigued. **g)** the student is in generally good health.	Suggested motivation: Introduce the "nonsense syllable" exercise (see Appendix). Elicit that studying is most effective when the ideas are clearly understood (Column B) and when there is an understanding of the relationship between the ideas (Column C). Use the "Limerick" exercise (see Appendix) to show that distractions interfere with studying. Point out that physiologically it is better to study when one is not tired. Discuss the possible effects of leaving work till the last minute. Elict that for most people this practice produces stress.	Discuss how to do a homework assignment. Bring in copies of former civil service examinations. Have the class analyze the type of questions and suggest methods of preparing for this examination. Analyze a paragraph and show how to read for understanding. Discuss the "Mastery Learning" approach in studying for an examination. The student first tests himself on the material. Then the student studies only that portion of the material he missed on the test. Elicit the benefits of this approach.

Topic F: *How do we differ in ability?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that humans inherit many types and degrees of abilities. • identify three types of ability. • recognize that tests have been designed to measure and identify abilities. • recognize that intelligence may be considered the rate at which a person learns; however, there is disagreement as to its true definition. • recognize that scientists disagree as to what intelligence tests measure. • identify emotions, environment, and training as influences on expression of abilities. • distinguish between having an ability and making use of that ability.	We inherit certain basic abilities. There are many types of abilities. Among them are: a) memorizing b) problem-solving c) manual dexterity Tests have been designed to measure and to identify our abilities. Intelligence may be considered the rate at which a person learns; however, there is disagreement as to its true definition. Although there are many intelligence tests, scientists disagree as to what they really measure. Our emotions influence how we show our abilities. Our environment and our training influence how we show our abilities. Each person has different degrees of abilities. For example, one may excel in art and do poorly in athletics.	Suggested motivation: Bring in examples of questions taken from intelligence tests. Examine the questions and ask the class what the questions are actually measuring. Elicit that although intelligence is related to the rate of learning, there is no complete agreement on what intelligence is or on how it can be fully measured. Also, there are many types of abilities other than intelligence. Discuss that abilities can be affected by training and environment. Elicit that individuals with lower mental abilities, with effort, can often accomplish as much, or more, as individuals with higher mental abilities who exercise little or no effort. Elicit the concept that anger, joy, conflict, and other emotions influence the expression of our abilities. Although interest and ability usually go "hand in hand," one may be interested in listening to music without having the musical ability to play an instrument. Point out that opportunities are available in many fields for all levels of ability. For example: a student may not have the ability to be an architect, but may qualify as a draftsman.	Bring in various types of aptitude tests. Invite the school educational-vocational counselor to discuss vocational testing and suggest centers that administer these tests. Discuss the effect of different environments on the abilities of identical twins. Bring in the results of aptitude tests of anonymous pupils that indicate a wide range of various abilities in the same individual. Discuss the lack of correlation between inherited physical characteristics and a specific ability. According to Piaget, the rate of learning is dependent on the readiness of the individual.

Topic G: *Why is adolescence a period of stress and strain?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize the fact that every age group has its own individual physical and emotional problems. • identify adolescence as the period between childhood and adulthood. • define an endocrine gland. • define *hormone.* • identify the pituitary gland as the "master gland." • identify the roles of the hormones secreted by the thyroid, adrenal, testis, and ovary. • recognize that puberty is a time of hormonal change which may produce emotional and physical difficulties. • recognize that conflict between physical maturity and dependence on adults leads to emotional stress.	Every age group has its own individual physical and emotional problems. Adolescence is the period between childhood and adulthood. During the adolescent period there is an increase in the secretion of some of the endocrine glands. Endocrine glands are ductless, internal glands which pour their hormones directly into the blood stream. A hormone is a chemical messenger that can influence growth and behavior. The pituitary gland is a "master gland" which controls most of the other endocrine glands. It also controls height. The thyroid gland controls the rate of oxidation of food. The adrenal glands secrete adrenalin which prepares our body for an emergency. During the adolescent period, known as puberty, the sex organs (testes and ovaries) secrete the sex hormones that control the development of the characteristics of maleness and femaleness.	Suggested motivation: Explain to the class that although the reflex response in late adolescence is excellent, the rate for automobile insurance is much higher for adolescents than for those over 23. Since insurance rates are based on statistics, this indicates that adolescents have more automobile accidents than any other group. Why is this so? What problems do other age groups have? Why do adolescents have their own special problems? Develop the idea that the adolescent period has its own problems which lead to stress and strain and that these problems may be reflected in the behavior pattern. Develop the concept that adolescence is a period of rapid physical change. What evidence is there that adolescence is a period of rapid physical change? What is causing these changes in the body? Discuss the problems associated with the condition of acne. Discuss the role of the endocrine system with specific emphasis on the role of the pituitary gland, the thyroid gland, the adrenal glands, and the sex organs in bringing about physical maturity.	Create a role-play situation and ask pupils to act out the role of mother, father, teenager, and friends. Hand each participant an index card indicating his role and the situation. Ask the students to solve the following problems: **a)** Why are adolescents particularly likely to get into arguments with their parents? **b)** How might such arguments be prevented? **c)** Why do some pupils often create disturbances in the classroom? **d)** Why is dating a special problem during adolescence? **e)** Why do teenagers tend to "follow the crowd"? Have the pupils take stock of themselves by completing the checklist found in *Biology and Human Progress,* fifth edition, p. 223. Use charts, pictures, and slides to show endocrine function. Discuss the fact that adolescents get conflicting messages: "Grow up." — "Do as I say." "Think for yourself." — "Follow instructions." "Be independent." — "Don't talk back."

These hormonal changes may result in emotional and physical difficulties.

The adolescent is physically mature but requires further education before he can take his place in our complex society. The conflict between physical maturity and dependence on adults may lead to emotional stress.

Group acceptance and approval is particularly important because of the many changes taking place.

Discuss how needs change as a person matures. An adolescent outgrows childhood needs but has not yet developed adult behavior.

Childrens' needs are more physical whereas those of teenagers are more emotional:

a) recognition
b) love
c) independence
d) plan for the future
e) development of personal standards

Elicit that the emotional needs of the developing adolescent are often in conflict with the ways in which both the adolescent and the parent have been behaving in the past and continue to behave.

The problem is how to adjust when one foot is in the "child world" and the other foot in the adult world.

Topic H: *How do you handle emotional conflict?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that emotional conflict is normal to everyone. • identify five factors of emotional conflict. • recognize that the only way to resolve conflict is through compromise.	All people are faced with emotional conflict. As you grow up the conflicts become greater. Factors of emotional conflict are: **a)** personal threshold of upset **b)** feeling about self **c)** social problems **d)** educational problems **e)** vocational problems Emotional conflict causes many unpleasant feelings, upset, and self-doubt. Adolescents experience many conflicts with parents concerning "dependence" and "independence." Conflict must be resolved through intelligent problem solving, but this is often interfered with by emotions. Conflict is a normal part of life and a person must learn to resolve conflict through compromise. This is the healthy approach.	Suggested motivation: Explain that we are always faced with making choices. Elicit that emotional conflict comes from being faced with choices: **a)** study — play ball **b)** go with guys — go with a girl **c)** work — play Establish that whatever the decision, there will be frustration. All choice involves frustration or not achieving a goal. "Stay home to study. — Go on date" What is the frustrated goal with either decision? Elicit some factors of emotional conflict. Freud said we seek pleasure, but what happens when either choice has an unpleasant effect? Elicit areas where parents and adolescents have conflict. Have the students give examples of conflicts between people, between a person and a situation, and internal conflict. Have the students suggest compromises to resolve the conflicts suggested above.	Consider the following questions that may arise in the life of a teenager and can create emotional conflict: Am I different from others? Is there enough time in the day? Can I succeed at what I want? Am I preparing for a good life? Will I be able to get a good job? What will I do after high school?

Topic I: *How do some people attempt to escape from emotional conflict?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that some people avoid emotional conflict by escaping from the reality of the life situation. • identify harmful forms of escaping from emotional conflict. • recognize that alcohol and narcotic drugs become habit forming. • recognize the role of peer pressure in drug abuse including alcohol. • identify effects on mental and physical health resulting from the use of narcotic drugs and alcohol. • identify the cause and effect relationship between substance abuse and organ damage. • compare and contrast substance abuse and mental illness.	Some people seek to avoid emotional conflict by escaping from the reality of the life situation. Harmful forms of escape are: **a)** alcohol **b)** drugs **c)** neurosis **d)** psychosis **e)** suicide Alcohol and narcotic drugs become habit forming. Adolescents often start alcohol and drug use through peer pressure and don't know or believe the dangers. Some effects on mental and physical health resulting from the use of narcotic drugs and alcohol are: **a)** addiction develops **b)** amount needed to "feel good" grows **c)** personality changes occur as use and need become greater **d)** hallucinations, illusions occur **e)** inability to distinguish between real and dream world develops **f)** organs of the body can be damaged by continued use of drugs, including alcohol	Suggested motivation: "Why do some people get very tired just before a big exam for which they have not prepared?" "Why are some students absent on exam day?" Elicit that some people tend to try to escape from unpleasant situations. (Some methods of escape are more serious than others.) Discuss harmful methods of escape. Why are there age laws on use of alcohol and regulations (prescriptions) on use of narcotics? Drug and alcohol rehabilitation centers try to use "cured" addicts as personnel. Why? Can an addict really be "cured"? Compare and contrast drug and alcohol abuse with mental illness. Point out the harmful physical effects of substance abuse on organs of the body. Elicit the pressures that may exist to use drugs, including alcohol. Discuss techniques that might be employed to resist these pressures. Discuss the dangers of sniffing glue, using LSD, PCP (angel dust), and other hallucinogens.	Secure news articles on use of, laws, etc, pertaining to alcohol and drugs. Refer to *Narcotics Handbook* (available from the New York City Police Department) to discuss dangerous ingredients. Develop a list of slang expressions for drugs. Why would terms like "dope," and "goof balls" be used? What does this suggest? Invite SPARK worker or someone from local Alcoholics Anonymous and/or drug rehabilitation center to visit class.

Topic J: *How may tobacco be harmful to our bodies?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that smoking may shorten the life span of the individual. • interpret presented data on the effects of cigarette smoking on human health. • evaluate the significance of breaking the smoking habit.	Research has shown that smoking may shorten the life span of an individual. Statistics have shown that the amount of tobacco smoked is related to the number of cases of cancer of the lungs and circulatory diseases. There is evidence that breaking the smoking habit prevents further damage to the body.	Suggested motivation: Compare the filter tip of an unsmoked cigarette with one that is smoked. Note the difference in color. What causes the change in color? Using a filter-tipped cigarette, discharge smoke from a "smoking machine" into a clean, white tissue. Observe the stain. What does this show concerning the effectiveness of filter tips? Why do so many adolescents smoke? Point out that initiation into smoking is probably related to the need of the individual for acceptance by his peers. Smoking becomes a habit. Draw attention to the warning on a package of cigarettes: "The Surgeon General has determined that smoking is dangerous to your health." Develop by means of newspaper articles and statistical studies that smoking decreases the life span and is related to lung cancer and circulatory diseases. If smoking has already caused damage, what good would it do to stop smoking? Point out that discontinuance of smoking arrests the progress of the damage.	Carry out the destructive distillation of a cigarette by heating it in a test tube. Collect the distillate through a delivery tube in another dry test tube. Demonstrate the effect of this distillate by introducing it into a small aquarium containing a live goldfish or guppy. Have a reading lesson using materials from the American Cancer Society. Take the class to the library and ask the librarian to assist the class in obtaining statistical information about the connection between lung cancer and smoking. Compare the amount of money spent annually for tobacco and education. Invite a representative from the American Cancer Society to discuss its "stop smoking" program. Secure pictures of lungs of smokers and non-smokers.

Unit 6: *How Can We Prevent and Control Disease?*

Topic A: *How are diseases caused?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● explain that a disease is an improper functioning of the body. ● classify the different types of diseases. ● differentiate between an infectious and a non-infectious disease. ● indicate that a communicable disease is spread directly from one person to another. ● relate the type of disease to its cause. ● list three causes of infectious disease. ● identify a parasite as an organism that lives on or in another living thing and harms it.	A disease is an improper functioning of the body which shows up as symptoms. Diseases may be classified as: a) infectious diseases caused by 1. bacteria 2. viruses 3. fungi 4. worms 5. protozoa b) degenerative diseases caused by weakened organs. c) deficiency diseases caused by 1. lack of vitamins 2. lack of other nutrients d) endocrine diseases caused by glandular disturbances e) cancers and tumors f) allergies g) auto immune diseases An infectious disease is caused by parasitic microorganisms, viruses, or parasitic worms. A parasite lives on or in another living thing and harms it. A communicable disease may be spread directly from one person to another by various means: a) direct contact b) indirect contact c) droplet infection d) animal bites e) polluted water and air	Suggested motivation: Pellagra is a disease that was common in the South many years ago. Scientists from all over the world went there in the hope of finding a cure by finding the germ that caused the disease. None of the investigations revealed the germ. Dr. Goldberger noted that the disease was more common among poorer people whose diet consisted mainly of salt pork (mainly consisting of fat) and corn pone (corn meal). If you were Dr. Goldberger, what would you suspect was the cause of pellagra? How would you check your "hunch?" How is the cause of pellagra different from the cause of the common cold? Pellagra is a vitamin deficiency disease. Why can you "catch" a cold? The common cold is caused by a virus. Elicit the various causes of disease, giving specific examples of each. Contrast disease caused by organisms with diseases that are noninfectious. Point out the difference between infectious and communicable diseases.	Show pictures or slides illustrating the symptoms of various types of diseases. Establish that diseases are typed according to cause. Bring to class pictures, charts, and specimens of various types of microorganisms, viruses, and parasitic worms. Discuss the value of periodic health checkups to discover defects of organs before serious damage occurs. Show the film "Microorganisms That Cause Disease" from Coronet Instructional Films. Show the film "Unseen Enemies," available from Shell Oil Company.

Topic B: *How do bacteria affect us?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● differentiate between harmful and helpful bacteria. ● list two ways in which bacteria are helpful. ● describe how harmful bacteria cause disease. ● define the term *sterile*. ● list three ways by which objects can be sterilized.	Bacteria are neither plant nor animal and are found everywhere, (and are considered monera). Most bacteria do not cause disease—in fact, some are helpful. Some bacteria may be helpful in the following ways: a) Bacteria of decay return minerals to the soil by breaking down dead plants and animals. b) Some soil bacteria form nitrogen compounds from the nitrogen compounds in the air. These nitrogen compounds are used by plants to grow. c) Bacteria are used in industry to make cheese, process leather, and produce drugs and other products. d) Some bacteria aid in the production of vitamins such as vitamins B_{12}, B_2, and K. Some bacteria cause disease by feeding on our tissues and may release poisons called toxins. Sterile objects are free of all living microorganisms. Objects can be sterilized by extreme heat, long-time exposure to ultraviolet light, and chemicals called disinfectants.	Suggested motivation: Expose sterile Petri dishes with agar to air and various objects such as skin, clothing, pens, combs, doorknobs, water, food, money, and anything else. Use a control. *(Caution:* keep Petri dishes closed after inoculation.) Develop the concept that bacteria are found everywhere. Why didn't the bacteria grow in the control? Discuss the preparation of the nutrient agar and methods of sterilization and bacteriological technique. If bacteria are found everywhere, why aren't we all sick? Develop the concept that most bacteria do not cause disease and that some are helpful. Elicit ways in which bacteria are helpful. Elicit from students that the taking of antibiotics can cause intestinal upset and diarrhea. Develop the idea that antibiotics can kill helpful as well as harmful bacteria.	Have pupils examine a bean infusion under a microscope. Bring clover to class and examine the roots for nodules. Discuss the origin of the holes in Swiss cheese. Laboratory experience: Test the validity of the disinfectant claims of various cleaning products by inoculating sterile Petri dishes with bacteria and then swabbing with the various disinfectants. Stain and examine nonpathogenic bacteria under a microscope. Observe that bacteria exist in three basic shapes. Laboratory lessons using microviewers and film strips from *National Teaching Aids, Inc.* "Helpful Bacteria," "Harmful Bacteria." Show film "Millipore Technology," 20 min., color, free from Millipore Corp, Bedford, Mass.

Bring in an x-ray of an advanced case of tuberculosis and point out that the bacteria have actually fed on the lung tissue, causing cavities.

Scientists experimenting with the effects of microorganisms in the body killed diphtheria bacteria and injected them into a human. They were most amazed to discover that the individual came down with a severe case of diphtheria. How can this be explained?

Elicit that some bacteria produce poisons called toxins and these toxins cause the disease.

Topic C: *How do our bodies prevent microorganisms from entering?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • describe three ways by which bacteria may be carried to his/her body. • identify the skin as the first line of defense against invasion by microorganisms. • describe how normal openings in the skin are protected. • list four common skin ailments. • describe the role of cleanliness in preventing disease.	Microorganisms are carried to our bodies by: **a)** direct contact (with persons having the disease or from objects they have used) **b)** droplets of water (coughing and sneezing) **c)** air and soil **d)** contaminated food and polluted water **e)** insects and other animals. The unbroken skin is the first line of defense against the invasion by microorganisms. The cilia and the mucous membrane of the nose and throat help prevent microorganisms from entering through body openings. The digestive juices in the stomach destroy bacteria. Some common skin ailments are: **a)** skin rashes due to allergies or nervous upset **b)** pimples, blackheads, whiteheads **c)** ringworm of skin or scalp **d)** athlete's foot fungus **e)** fever sores **f)** impetigo **g)** warts **h)** dermatitis from cosmetics, deodorants, poison ivy, dandruff, and other causes	Suggested motivation: Why is a puncture caused by a rusty nail more likely to result in tetanus (lockjaw) than a nail which is not rusty? Develop the concept that it is not the rust that causes the disease but the presence of rust indicates that the nail may have been in contact with soil that harbored the microorganism. Elicit other means by which microorganisms are carried to the body. Why is it dangerous to have a cut or a burn? Develop the concept that the skin is the first line of defense. What parts of the body are not protected by the skin? How are these parts protected? How may the skin itself become diseased? Elicit and discuss the common skin ailments and methods for prevention and treatment. Stress cleanliness.	Discuss the value of various types of soaps on the market. Put a used powder puff on a sterile agar plate. Incubate. Count colonies later. Compare with the control dish. (*Caution:* Keep dishes sealed after contamination.) Take two agar plates. Touch the surface of one with an unwashed hand. Wash the hand and touch the second surface. Incubate and then compare the difference. (*Caution:* keep the dishes sealed after contamination.) Tell the story of Typhoid Mary and discuss health regulations that apply to food handlers. Stress the need for expert medical advice instead of the haphazard use of "patent medicines." Discuss the role of insects as vectors of disease in malaria, encephalitis, bubonic plague, typhus, and yellow fever. Point out the role these diseases have played in civilization. Refer to *Rats, Mice, and History,* by Hans Zinsser. Obtain pamphlets relating to good grooming practices from companies such as Proctor and Gamble, Cincinnati, Ohio. Use these pamphlets for reading lessons.

Cleanliness helps to maintain the effectiveness of your skin as a defense.

If you acquire a skin ailment, medical advice should be sought.

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Topic D: *How do our bodies defend themselves against organisms that have invaded them?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify antibody formation and white blood cells as the body's second line of defense against microorganisms. • contrast active and passive immunity. • differentiate between natural and acquired immunity. • explain the principle of vaccines in developing immunity. • list the types of immunization used today. • identify the diseases for which active immunization is recommended. • describe the role of white blood cells in protecting against disease.	As part of our second line of defense against microorganizms we have chemicals in our blood called antibodies. We are immune to a certain disease if we have the specific antibody against that disease. Being immune to a certain disease does not mean you are immune to another. We are born with the ability to make certain antibodies. Our bodies may be "taught" to make other antibodies by means of vaccines that contain dead or weakened microorganisms or their weakened toxins. The shots that every person should have include: (Some people may be allergic to these shots.) triple vaccine (DPT) for tetanus, diphtheria, and whooping cough (pertussis) Polio vaccine consisting of the Sabin live viruses administered orally Measles vaccine Rubella vaccine Mumps vaccine Since immunity may not last a lifetime, it is important that booster shots be given periodically.	Suggested motivation: Compare the incidence of diphtheria and polio today as against 50 years ago. How do you account for the dramatic decrease in the number of cases of these diseases? Elicit that the decrease in incidence is due to a program of immunization that is usually followed in New York City. What is immunity? Elicit the meaning of immunity and discuss the role of antibodies in producing immunity. Point out that antibodies are chemicals in the blood that are specific in combating a certain disease. Why is it that some people never get measles? Elicit that our bodies make certain antibodies from birth on. We start to make other antibodies only after we have gotten the disease or been given a vaccine made of dead or weakened microorganisms or weakened toxins. Have the pupils list some of the shots they or their brothers and sisters have received. Discuss the nature of the inoculations received.	Bring in samples of human blood and prepare blood smears for examination. Discuss the work of Roux and von Behring in the development of a means for producing antitoxins. Collect samples of various vaccines. Using a single concept film loop, show that toxins and antitoxins are specific for each other. Discuss the preparation of the Sabin trivalent vaccine. Information is usually enclosed with the vial of vaccine.

Antibodies obtained from another human being or animals may be given after exposure to the disease to insure immunity. However, this type of immunity is not long lasting.

Our second line of defense against the invasion of microorganisms includes the white blood cells in our bodies.

An increase in the number of white blood cells or the swelling of a lymph gland (tonsils or glands in the neck and elsewhere) may be indications of an infection in the body.

Why would it be unwise to depend only on a vaccine of weakened tetanus toxin if you had already been punctured by a dirty nail?

Discuss the nature of tetanus antitoxin to establish immediate immunity. Extend the discussion to include the use of gamma globulin in women when exposed to German measles during pregnancy.

How does a doctor determine that an attack of appendicitis is serious enough to call for an operation?

Develop the idea that the body increases the number of white blood cells whenever the body is invaded by microorganisms. Elicit that the white blood cell feeds on the microorganisms.

Develop the concept that swollen lymph nodes such as tonsils and glands under the jaw, in the armpits, or in the groin indicate infection.

Topic E: *How do we fight bacteria that cause disease?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● identify sexual contact as a means of bacterial spread. ● identify a bacterium as the cause of syphilis. ● define a venereal disease. ● identify outcomes of untreated syphilis. ● recognize the symptoms of syphilis. ● state that syphilis can be treated with antibiotics. ● define an antibiotic and be able to recognize examples of antibiotics. ● state that antibiotics are limited in their effectiveness. ● recognize means of preventing syphilis. ● identify gonorrhea as a very common venereal disease. ● explain various means by which bacteria may be spread. ● match diseases and modes of transmission for specified diseases.	Bacteria can be spread by sexual contact. Syphilis is caused by a bacterium. A venereal disease is a disease in which the microorganism is spread by sexual contact. Syphilis, if untreated, can cause: **a)** heart damage **b)** brain and spinal cord damage causing paralysis, insanity, and eventually death If the mother has untreated syphilis, the newborn child can have birth defects or be born dead. The symptoms of syphilis change as the disease progresses. They are: Stage I: A reddish sore called a chancre which appears 12 weeks after contact Stage II: Rash on chest, back, arms and legs, one to six months after contact State III: Ulcers on skin, loss of feeling in arms and legs, and pain and disability, three years of more after contact Syphilis is treated by the use of antibiotics (penicillin).	Suggested motivation: Why are people required to have a blood test to obtain a marriage license? Elicit that the test is for syphilis. Establish the definition of a venereal disease. Why is syphilis one of the most dangerous of the sexually transmitted diseases? How would a person know if he/she had syphilis? Discuss the role of antibiotics (usually penicillin) in the treatment of syphilis. Discuss resistant strains of bacteria. How are the public health authorities working to prevent syphilis? Why do they put drops in newborn babies' eyes? Identify gonorrhea as a very prevalent venereal disease. Suggested motivation: Demonstrate a box of tissues and ask, "Why should you cover your mouth when you cough?" Elicit that pathogenic microorganisms can be spread by means other than sexual contact.	Discuss why the incidence of sexually transmitted disease is increasing. Use a pamphlet available from either a state or city health agency as the basis for a reading lesson on either syphilis or gonorrhea. Have a guest speaker from the Department of Health or from the local hospital.

An antibiotic is a chemical obtained from molds, bacteria, or synthesis that interferes with the growth of bacteria.

Antibiotics are effective only against certain microorganisms.

The ultimate answer to the syphilis problem is prevention by isolating the sources of infection.

Gonorrhea is another sexually acquired disease caused by a bacterium.

Gonorrhea is the most common communicable disease after the common cold.

Bacteria may be spread by:

a) dust particles in the air
b) droplet infection
c) contact with articles handled or used by an infected person
d) food and water containing disease-causing bacteria
e) direct contact with infected people.

Discuss examples of diseases transmitted by these other methods.

a) dust particles in the air — conjunctivitis (pink eye)
b) droplet infection — strep throat, tuberculosis
c) contact with articles — tetanus, impetigo, diptheria
d) contaminated food and water — typhoid fever, earaches, salmonella (food poisoning)

Topic F: *How do we fight viral diseases?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • explain that viruses are too small to be seen with ordinary light microscopes and can only be seen with an electron microscope. • list seven diseases caused by viruses. • describe at least two ways by which viral diseases are transmitted. • explain that antibiotics are not effective against most viruses. • explain that antibiotics may be given during viral infections to prevent secondary bacterial infections. • explain that it is difficult to produce effective vaccines because viruses continually change (mutate).	Viruses are very, very small microorganisms which can only be seen with an electron microscope. Viruses may be transmitted by droplet infection, sexual contact, contaminated foods, contaminated articles such as hypodermic needles, and bites of infected animals. Some diseases caused by viruses are: common colds, polio, rabies, measles, hepatitis, smallpox, mumps, influenza, viral pneumonia, fever blisters (herpes simplex), and genital herpes. Scientists have found it difficult to control diseases caused by viruses with antibiotics. There is no anitbiotic effective against the viruses which cause the common cold. Antibiotics are given to fight off secondary bacterial invaders that enter the body because of lowered resistance as a result of viral infec-infection. Continued use of an antibiotic might result in strains of microorganisms that are resistant to the antibiotic.	Suggested motivation: Why aren't the existing cold vaccines very effective in producing immunity to the common cold? Develop the idea that we are not too well acquainted with viruses because they are so small, and probably there are many different viruses that cause the common cold. Why were we able to make a vaccine against polio even though it is caused by three strains of viruses? Elicit that the three strains that cause polio have been isolated and identified. Viruses which cause other diseases have been identified but viruses mutate and therefore it is difficult to produce effective vaccines. What other diseases are caused by viruses? Why is genital herpes a major concern today? Why are we less successful in treating viral diseases with antibiotics? Why will some doctors prescribe antibiotics for the common cold and other viral diseases? What danger is there in prescribing antibiotics for every minor ailment?	Show pictures of viruses. Consider the method by which Pasteur developed the rabies vaccine. Elaborate on the discovery of the Salk and Sabin vaccines against polio. Discuss why it is no longer necessary to be vaccinated against smallpox.

Topic G: *How do we fight the protozoan that causes malaria?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify a protozoan as the cause of malaria. • state that malaria is spread from person to person by the bite of a certain type of female mosquito. • explain how malaria can be controlled. • list two other insects that spread disease-causing microorganisms.	More people all over the world suffer from malaria than from any other infectious disease. Malaria is caused by a one-celled animal called a protozoan. The protozoan which causes malaria is carried by a certain type of female mosquito. Malaria is very common in certain warm countries where the mosquito that carries the protozoan is plentiful. Malaria is spread from person to person by a female mosquito. The malaria protozoan lives inside the red blood cell causing fevers and chills. Malaria may be treated by using quinine, Atabrine, and some new drugs. Malaria is controlled by wiping out the mosquito. This is done by using insecticides and destroying the breeding places through draining swamps and cleaning up rubbish.	Suggested motivation: Relate the following to the class: "Malaria attacks over 350 million people each year. This means that one out of every ten people in the world will come down with the disease each year. Why isn't malaria a major problem in the United States today?" Elicit that malaria is caused by a protozoan that lives in the red blood cell of man and is transmitted from person to person by a certain female mosquito that is not common in the United States. How are cases of malaria treated? How is malaria controlled? What relationship is there between malaria and the underdevelopment of a country? Suggested motivation: Why should you check your clothing and your body for insects when you have been in a wooded area? Elicit that insects act as carriers of disease-causing organisms. Discuss the following examples: a) Rocky Mountain spotted fever — tick b) African sleeping sickness — tsetse fly c) Encephalitis — mosquito d) Typhus — body louse e) Typhoid — housefly f) Dysentery — cockroach	Show the film "Winged Scourge." from *Inter-American* Using a chart, discuss the life cycle of the *Anopheles* mosquito. Discuss the importance of Atabrine and quinine from the military point of view. Discuss the importance of cleaning up the breeding places of the mosquito in the United States as related to the problems of encephalitis and malaria. Why can't people who have had malaria give whole blood? Why are there "rat guards" on mooring lines connected to ships?

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Topic H: *What worms cause human illnesses?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● identify by name five parasitic worms. ● identify how each type of parasitic worm enters the body and which part of the body it inhabits. ● explain how each type of worm can be prevented from entering the body.	Some worms are parasitic in humans. Some parasitic worms are: the tapeworm, the hookworm, the trichina worm, the roundworm, and the pinworm. The tapeworm, the hookworm, the pinworm and the roundworm live in the intestine of humans. The trichina worm lives in the muscles of humans and pigs. Infected meat can be a source of trichina or tapeworm. Parasitic worms can enter the body through the mouth or bare feet. Parasitic worms can be controlled by proper sanitation, meat inspection, thorough cooking of meat, and wearing shoes. Since parasitic worms may enter through the mouth, it is important to wash your hands, particularly after playing with your pet.	Suggested motivation: Why should you wash your hands after playing with your pet? Elicit the dangers of picking up tapeworm, pinworm and roundworm. Indicate that the more usual method of getting these worms is through infected food or dirty infected articles placed in the mouth. Why must pork be thoroughly cooked? Elicit that the trichina worm lives in the muscle of the pig and is able to burrow out of the walls of the intestines in man if he eats uncooked infected pork. The worm then lives in the muscles of man and can cause severe pain and damage or death. Dissect a frog and demonstrate by means of a bioscope the parasitic worms in the heart, lungs, liver, or intestine. Elicit that some worms are parasitic and that parasites live in or on another living organism and harm it. Why is the number of people suffering from hookworm related to the number of people who do not wear shoes? How can we control the worm diseases?	Bring in preserved specimens of parasitic worms. Discuss the life cycles of tapeworm, hookworm, and trichina worm. Consider the danger of dieting by taking pills containing tapeworms. Set up a microscope demonstration of a trichina worm encysted in pork muscle. Discuss the dangers of tasting raw meat or fish. Take the class to visit a parasitology laboratory. Bring in patent medicines used to worm dogs and read the instructions.

Topic I: *How can cancer be controlled?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● explain what cancer is. ● distinguish between the terms malignant and benign. ● recognize that scientists do not know the exact cause of certain cancers. ● identify factors creating conditions favorable for cancer development. ● recognize that cancer can be cured if treated early enough. ● identify the seven warning signs of cancer. ● explain how cancer spreads throughout the system. ● identify methods of treatment.	Cancer is an uncontrolled growth of the body's own cells. A growing mass of cancerous cells is called a malignant tumor. Scientists do not know the cause of all cancers, but the latest evidence seems to indicate that viruses may be involved in some cases. Another possible cause is changes in the body's immune system. Research has shown that there are many chemicals and substances which create a condition favorable for the development of cancer. Among those identified are: **a)** radiation such as x-rays and radioactivity **b)** too much sunlight **c)** constant irritation **d)** substances made from coal tar **e)** substances contained in cigarette smoke **f)** asbestos fibers **g)** polluting substances in air or water Cancer can be cured if treated early enough. The warning signs of cancer are: **a)** any unusual lump or thickening, especially in the breast **b)** a surface sore, especially near the mouth, which fails to heal in the normal way	Suggested motivation: Read the caution, "Cigarette smoking is dangerous to your health," on a package of cigarettes. Why does the United States government require that this warning be printed on every pack of cigarettes? Elicit that statistical evidence indicates that smoking caused an increase in lung cancer. Demonstrate the effect of cigarette smoking using the "smoking machine." Discuss the nature of cancer and contrast the growth of cancer cells with normal controlled cellular growth. Introduce the terms malignant and benign. What is the cause of cancer? Develop the concept that the cause of cancer is unknown, but the latest evidence points to viruses or changes in body immunity in some forms of cancer. If the cause of cancer is unknown, what is the role of cigarette smoke? Elicit that certain factors create a condition which is favorable for the development of cancer. Discuss these factors. What are the danger signals that should send you to a doctor? Why is the early treatment of cancer important? How does the doctor treat cancer?	Induce the growth of cancer (crown gall tumor) in carrots by means of *Agrobacterium tumafaciens.* Place sterile slices of carrots on steril agar in a Petri dish and prick the top surface with a sterile needle. Cover the carrot slices with the bacterial suspension and incubate at room temperature in the dark. Crown gall tumors should appear after one or two weeks. Employ the teaching kit *Nature of Cancer* obtainable from the American Cancer Society. The kit contains background information sheets, student activities, and transparencies, which may be used for reading lessons and laboratory experiences. This kit also contains a smoking machine. Show films from the American Cancer Society (available free of charge). Use pamphlets available from the National Institutes of Health such as *Asbestos Esposure,* or from the Memorial Sloan-Kettering Cancer Center (212) 794-7982. Contrast benign and malignant tumors. Discuss the necessity for biopsy. Discuss the various types of cancer such as leukemia and cancer of the thyroid.

c) unusual discharge or bleeding from any body opening
d) changes in the size or color of moles or warts
e) repeated attacks of indigestion
f) hoarseness that does not clear up
g) change in bowel or bladder habits

Some types of cancer cells may break off and travel to other parts of the body where they may start a new growth.

Since scientists do not know how to change a cancerous cell into a normal cell, treatment consists of removal or destruction of the cancerous cell by means of surgery, radiation, and/or chemotherapy.

Show pictures of a radioactive cobalt machine and consider the role of radioactive isotopes as related to tracers and a source of radioactivity for treatment of cancer.

Discuss the dangers of radioactive fall-out.

Class trip to Sloan-Kettering for an organized tour.

Explain the use of the Pap test.

Topic J: *What are some common noninfectious diseases?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • indicate that there are diseases not caused by microorganisms. • identify diabetes as a disease resulting from a deficiency of the hormone insulin. • list three causes of noninfectious diseases. • explain what an allergy is. • identify substances that cause allergic reactions. • recognize the symptoms of an allergic reaction. • recognize that the same substance can cause different allergic reactions in different people. • interpret a line graph to extract pertinent information. • explain how to handle a poisoning situation. • identify two diseases that may be associated with aging. • recognize at lease two safety practices to prevent accidental poisoning.	Noninfectious diseases are not caused by microorganisms. They may be caused by: dietary deficiency, hormone deficiency, allergy, breakdown of body parts, and poisoning. Diabetes is a hormone deficiency disease in which sugar is incompletely used in the body and excreted in the urine. This is caused by the failure of the pancreas to produce enough insulin. An allergy is a sensitivity to certain pollens, foods, dust, feathers, or other substances. Reactions to allergies range from mild to severe and may include: **a)** itching **b)** rashes **c)** coughing, sneezing, runny nose **d)** nausea, vomiting, diarrhea **e)** shock and death People with the same allergy can have different allergic reactions. Poisons and/or accidents can damage body parts and systems. In the event of a poisoning, label instruction should be followed and the Poison Control Center contacted.	Suggested motivation: A person who has diabetes has too much sugar in his/her blood. Why do diabetics usually carry a supply or sugar with them? Establish that diabetes is a noninfectious disease because it cannot be transmitted. Develop the idea that diabetes is a hormone deficiency disease in which sugar is incompletely burned in the body and is caused by the failure of the pancreas to produce enough insulin. Diabetics take insulin by injection or drugs by mouth that stimulate the pancreas to produce insulin. An overdose of insulin produces insulin shock. Some types of diabetes can be controlled by proper dieting. Why will an overdose of insulin produce unconsciousness? Develop the concept that the level of sugar in the blood must be kept constant because either too much sugar (diabetic coma) or too little sugar (insulin shock) will cause unconsciousness. How does the body get rid of excess sugar in diabetics? At what age does diabetes occur?	Tell the story of Banting and his work with insulin. Use Clinitest tablets to test urine, or use Tes-tape. Consider with the class the need for wearing or carrying a medical identification tag if you are diabetic or allergic. Obtain newspaper clippings and magazine articles showing pollen counts. Bring in examples of ragweed and discuss programs of eradication. Point out the dangers of using unprescribed allergy medicines. Show Riker mounts of poison ivy and poison sumac and discuss methods of contact and treatment. Reading lesson: *Plants That Poison*, obtainable from Geigy Agricultural Chemicals, Ciba-Geigy Corporation, Saw Mill River Road, Ardsley, N.Y. 10502 Have students copy directions for antidotes on labels of common household products. Discuss pica as a possible danger for lead posoning.

Suggested motivation:

Ask the class to discuss their own allergies. Develop the concept that an allergy is a sensitivity to a particular substance.

How do you find out what you are allergic to?

Establish that people with the same allergy can have different alleric reactions.

Develop the concept that many people develop the symptoms without knowing specifically what they are allergic to.

Allergy tests may be given by inoculating the person with various substances to test for allergic reactions.

Why is the pollen count reported in newspapers and on the radio during the spring and summer? Use graphs in the Appendix to develop an understanding of the relationship between pollen count and the number of people with hay fever reactions.

Suggested motivation:

Show class a bottle with a safety cap, a plastic electrical safety plug, and a car seat belt.

Why should we be protected from things other than microorganisms?

Elicit that accidents and poisoning can cause illness as well as death.

Discuss ways of preventing accidental injury. Stress safety precautions.

Elicit potential sources of poisoning in and around a household.

Have students look up the telephone number of the local Poison Control Center.

Invite a guest speaker from the Poison Control Center.

Discuss what steps may be taken to prevent poisoning. Emphasize following label directions in the event of a poisoning and calling the Poison Control Center.

Explore the question of aging and degenerating body systems which lead to chronic and disabling diseases such as circulatory diseases, rheumatism, and arthritis as other forms of noninfectious disease.

Topic K: *How can we control the spread of disease at home?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify microorganisms as the agents of food spoilage. • recognize that food preservation techniques prevent the growth of microorganisms. • identify methods of food preservation. • state that food can be contaminated by disease-causing microogranisms. • distinguish between bacteria and the toxins produced by bacteria as the cause of botulism. • recognize that insects, mice, and rats may spread microorganisms that cause disease. • recognize that exposed food or litter attract household pests which may spread diseases.	Our food is spoiled by microorganisms. We preserve our food by preventing the growth of microorganisms. Methods of preservation include: smoking, salting, adding sugar, adding chemicals, dehydrating, pickling, canning, freezing. Food can be contaminated by disease-causing microorganisms. The toxins of some bacteria can cause food poisoning, for example, botulism, which may be fatal, or ptomaine poisoning. Insects, mice, and rats may spread microorganisms that cause disease. The presence of exposed food or litter may attract household pests. A house overrun with these pests requires the services of a licensed exterminator.	Suggested motivation: Ask students which milk they would rather drink — an unrefrigerated container of milk or a can of evaporated milk, both of which have been sitting on a shelf for several days. What causes food to spoil? Why may eating spoiled food be dangerous? What causes the puffiness in a can of spoiled food? How is the food in a can preserved? What other ways may food be preserved? What is the danger of refreezing food that has thawed out? Describe the use of rat guards when a ship docks. (A rat guard is a large disc with a hole in the middle through which the docking rope runs.) Why can rats be dangerous? What other household pests may carry disease-producing microorganisms? How can these household pests be controlled?	Discuss the influence of food preservation on civilization. Bring a can of spoiled food and point out its bulge. Bring to class examples of preserved food. Visit a milk-bottling or food-canning plant. Ask the home economics teacher to demonstrate the "home canning" of food. Demonstrate the results of improper canning. Examine a can for its control number (may be found pressed into the metal of the lid on tuna fish cans). Discuss the significance of a control number. Discuss the historical significance of bubonic plague. Show preserved specimens of various household pests. Bring to class various insecticides and rodent poisons. Read the labels noting the contents. Point out the dangers of using them carelessly and of leaving them where little children can get at them.

Topic L: *How do scientists identify and understand new diseases?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify a description of AIDS. • select and sequence the procedures medical scientists follow in identifying and understanding a new disease. • apply these procedures in solving a problem.	AIDS — acquired immune deficiency syndrome is said to occur when a person's body is unable to fight disease organisms because his/her immune system is not working. A scientist must: a) make observations and look for patterns in those observations b) think up questions to be answered c) work out ways to answer those questions d) come up with an hypothesis to explain what is observed e) check to make sure a theory fits all the known facts.	Suggested motivation: Detail the symptoms of AIDS. Why are scientists so concerned about AIDS? Examine the observations medical scientists made concerning the sequence of the appearance of the disease in various segments of the population. Explore the questions still to be answered. Discuss how answers for these questions might be obtained.	Conduct a reading lesson on attempts of scientists to understand AIDS, Legionnaire's disease, herpes, and some other disease. Have students bring in articles from newspapers and magazines about medical problem solving. Use the article in *Time* magazine, July 4, 1983, detailing the search for the cause of AIDS.

Unit 7: *How Do Humans Reproduce?*

Topic A: *Why are a male and a female needed to produce a baby?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that reproduction is the life process by which living things give rise to their offspring. • identify the significance of reproduction to the human species. • identify the cells taking part in human reproduction. • define fertilization. • differentiate between the sperm and the egg. • identify the sperm and eggs as gametes. • label a diagram of a sperm. • label a diagram of an egg. • relate each structure of the sperm and the egg to its function. • identify why only one sperm fertilizes the egg. • identify the sperm nucleus as containing genetic material from the father and the egg nucleus as containing genetic material from the mother.	Reproduction is the life process by which living things give rise to offspring. This results in keeping their kind of living thing in existence. Sexual reproduction is the process by which a new individual is formed from the combining of a sperm cell and an egg cell. Sperm and egg cells are called gametes (sex cells). The male gamete is called a sperm and is produced in an organ called the testis. The sperm consists of a nucleus and a tail. The nucleus contains the genetic material from the father. The tail enables the sperm to swim. The female gamete is called an egg and is produced in an organ called the ovary. The egg is much larger than the sperm. The egg consists of a nucleus and a yolk surrounded by a membrane. The nucleus contains genetic material from the mother. The yolk is a source of food. Fertilization is the combining of a sperm and an egg to form a fertilized egg which results in a new individual.	Suggested motivation: Display four photographs — one of a baby, one of two men, one of two women, and one of a man and a woman. Ask the class to suggest which of the photographs is most probably that of the parents of the child. Elicit that sexual reproduction is the process by which a new individual is formed from the combining of a sperm cell and an egg cell (gametes produced by the testis and ovaries, respectively). Develop a labeled diagram of fertilization including the parts of the sperm and the egg. Establish the functions of each part and the development of the fertilization membrane. Contrast the sperm and egg cells with regard to size. Attribute this difference to the presence of yolk.	Use the materials on reproductive physiology available from Tampax and Planned Parenthood, Inc. Conduct a reading lesson using appropriate articles on *in vitro* fertilization.

During fertilization the nucleus of the sperm combines with the nucleus of the egg.

During fertilization the egg cell membrane changes so that no other sperm can enter.

Topic B: *What are the parts of the male and female reproductive systems?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that sperm cells are produced and survive best at a temperature below that of the body. • identify the testes, which lie outside the body cavity, as the organs where sperm are produced. • identify by structure and function the parts of the male reproductive system. • define semen. • identify the substances which pass through the male urethra. • identify by structure and function the parts of the female reproductive system. • compare and contrast the functions of the urethra in males and females. • recognize that males can usually produce sperm until their deaths. • recognize that females produce only a set number of eggs in their lives.	Human sperm are produced and survive best at a temperature slightly below body temperature. Sperm develop in testes that are outside the body. The testes also produce androgens that are needed for proper sperm development. The vas deferens carries the sperm from the testes into the body cavity. As the sperm travel toward the penis, fluids from the prostate and other glands mix with the sperm to form semen. The urethra carries the semen through the penis to the outside. In males the urethra carries both semen and urine, but not at the same time. The parts of the female reproductive system include: **a)** ovaries — produce eggs and hormones **b)** Fallopian tubes — carry eggs from the ovaries toward the uterus **c)** uterus — organ in which the embryo develops (the neck of the uterus is the *cervix).* **d)** vagina — the birth canal. The female urethra carries only urine.	Suggested motivation: State that human sperm do not survive long at body temperature. Elicit that the testes which make the sperm are located in the scrotum outside the body cavity. State that the testes also produce androgens? (male sex hormones). Develop the concept that the vas deferens carries the sperm into the body cavity where they mix with liquids produced by glands including the prostate gland. In males the urethra carries both sperm and urine out of the body but not at the same time. Develop a labeled diagram of the male reproductive system. Suggested motivation: Ask why some couples have chosen to have a test tube baby? Elicit that there may have been some problem with the woman's reproductive system. Recall that eggs develop in the ovaries. By means of a diagram establish the structure of the female reproductive system. Compare and contrast the male and female urogenital systems.	Use materials on reproduction and physiology available from Planned Parenthood, Inc. and Tampax. Conduct a reading lesson using appropriate articles on *in vitro* fertilization. Discuss that mumps can cause sterility in males. Discuss the possible sterility that may be caused by prolonged undescended testicles. Discuss artificial insemination. Discuss prostate problems in older men. Discuss emotional problems related to menopause.

Males are able to produce sperm at any age, and at most times.

Females usually begin producing eggs during puberty, and cease at about age 40-50 (menopause).

Females usually produce one egg each month.

Topic C: *What is the menstrual cycle?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • define menstruation. • contrast menstruation and bleeding from a cut. • identify the follicle as the structure in the ovary in which the egg develops. • identify the developing follicle as a source of estrogen. • relate estrogen production to the buildup of the uterine wall and an increase in its blood supply. • identify the midpoint in the menstrual cycle as the time when ovulation occurs. • define ovulation. • identify the structure formed when the follicle ruptures as the site of progesterone production. • relate progesterone production to further development of the uterine lining. • recognize that the egg travels down the Fallopian tube and that if it is not fertilized the egg disintegrates. • identify that the structure in the ovary disintegrates and stops producing progesterone if the egg is not fertilized. • relate the decrease in progesterone levels to the onset of menstruation. • recognize that menstruation results from a peeling of the lining of the uterus and muscular contractions of the uterine wall.	At menstruation the lining of the uterus is shed. In the ovary each egg develops in a follicle. A developing follicle releases estrogen. Estrogen is a female sex hormone that causes the lining of the uterus to build up. It also increases the blood supply in the lining. Ovulation takes place midway in the menstrual cycle. Ovulation is the release of the egg from the follicle. The structure (corpus luteum) formed when the egg leaves the ovary produces a hormone called progesterone. Progesterone causes further development of the lining of the uterus. The egg goes down the Fallopian tube and if it is not fertilized, it disintegrates. If fertilization does not occur the structure in the ovary disintegrates and stops producing progesterone. Without enough progesterone the lining of the uterus peels off, breaking capillaries. The walls of the uterus contract causing the lining to be discharged in the menstrual flow.	Suggested motivation: Ask the class, "What happens during menstruation?" Elicit that the uterine lining (endometrium) is shed. Distribute or develop on the board a diagram showing the development of the ovarian follicle (available from Tampax or Planned Parenthood, Inc.) Elicit that the developing follicle produces the hormone estrogen, which causes growth in the uterine lining and an increase in its blood supply. Have available a paragraph describing the ovulation process. After the students have read the paragraph, refer them to the previously developed diagram of the female reproductive system and have them trace out the path of the ovum. Elicit from them the function of the corpus luteum, and what happens to it if fertilization does not occur. Indicate that if fertilization does not take place the corpus luteum disintegrates. No more progesterone is produced. Without adequate progesterone the lining of the uterus peels off, breaking capillaries. The walls of the uterus contract, causing the menstrual flow.	Contrast the menstrual cycle in humans with the seasonal estrus in deer. Point out that ovulation occurs regularly in the menstrual cycle but occurs only after mating in estrus. Discuss various pathological conditions of the female reproductive system such as: **a)** amenorrhea — absence of menstruation **b)** dysmenorrhea — painful or difficult menstruation **c)** menorrhagia — excessive menstrual discharge **d)** infections of bacteria, yeast, trichomonads, etc. Discuss the statement "The only thing regular about the menstrual cycle is its irregularity." How can people try to choose the sex of their baby? (the Shettles method)

• relate the production of hormones by the pituitary to the production of estrogen and progesterone and thereby to the timing of the menstrual cycle.	Hormones from the pituitary control the production of estrogen and progesterone. In this way these hormones from the pituitary control the timing of the menstrual cycle.	Relate some menstrual cramps to the contractions of the uterus. Establish that the timing of the menstrual cycle is due to pituitary hormones which control the levels of estrogen and progesterone in the body.

Topic D: *How does the human embryo develop?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify the site of fertilization. • recognize that sperm have to travel to reach the egg. • recognize that the egg begins to develop almost immediately after fertilization. • identify the uterus as the site of implantation and embryonic development. • recognize that the human egg is small and contains little stored food. • identify the functions of the placenta. • identify the relationship between the maternal and fetal circulation in the placenta. • recognize the role of the placenta in maintaining the developing embryo. • identify the structures and their functions from a diagram of an embryo *in utero*. • describe how the embryo is protected against injury from bumps and shocks. • identify cell division and cell specialization as the processes which create a many-celled organism from a single cell. • identify the steps in the birth process.	The human egg is fertilized in the Fallopian tube. The sperm have to travel a relatively great distance to get to the egg in the Fallopian tube. The egg begins to develop almost immediately after fertilization. The developing embryo becomes attached to the walls of the uterus where it continues to develop. The human egg is microscopic and contains very little stored food. By means of a special structure called the placenta, the embryo gets food and oxygen from its mother and gets rid of its wastes to its mother. The placenta also produces progesterone which prevents menstruation. There is no direct connection between the blood of the mother and the blood of the embryo. In the placenta, the blood vessels of the embryo are close to the blood vessels of the mother. Digested foods, oxygen, and wastes diffuse between them. The umbilical cord connects the embryo with the placenta. The embryo develops a membrane filled with liquid which acts as a shock absorber.	Suggested motivation: Display a model or a photograph of an embryo *in utero*. Elicit that embryos develop in the uterus. Develop the concept that if sperm are present, fertilization may take place in the Fallopian tube. Sperm swim a great distance to meet the egg in the Fallopian tube. Only a fertilized egg can become attached to the lining of the uterus. What special problems does an embryo, developing in a uterus, have? Elicit that the human egg is microscopic and contains very little stored food. Also, there is the special problem of obtaining oxygen and getting rid of waste. How are these problems solved? Discuss the role of the placenta, emphasizing that there is no direct connection between the mother's blood and the embryo's blood and that materials are exchanged by diffusion. How can the embryo develop from a microscopic cell? Point out the roles of cell division and specialization and discuss the period of development. Elicit how the fetus is protected during this period of development.	Visit the Hall of Man at the Museum of Natural History to see the exhibit on reproductive cycles and the development and birth of an embryo. Use cleavage models in class to show early embryological development. Using an atlas of embryonic and fetal development, a film strip, or the like, follow the development of the human being from conception to birth. Discuss pituitary gland actions on the birth process. Discuss birth by Caesarian section. Discuss miscarriage.

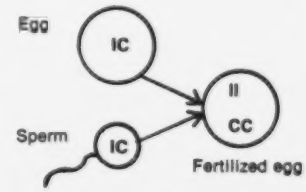
An individual starts out as one cell and after cell division and cell specialization becomes a many-celled organism.

At the close of the development period, the uterus starts a series of contractions. The fluid-filled sac breaks and the liquid flows out. The baby is born shortly afterward. The umbilical cord is cut. The baby now breathes air. Finally, the placenta is expelled as the afterbirth.

What are some indications that the pregnancy is over? Elicit that the uterus starts to contract and the shock-absorbing membrane breaks, releasing the fluid. These contractions force the fetus or baby out of the body of the mother. The placenta separates from the uterus and is also forced out.

Unit 8: *What Determines What We Are?*

Topic A: *Why do offspring look like their parents?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • identify the hereditary pattern contained in every cell of an organism as the determiner of the kind of organism it will be. • identify the chromosomes as the structures containing the hereditary pattern. • recognize that each kind of living thing has its own number of chromosomes. • recognize that chromosomes occur in pairs in most body cells. • recognize that when cells divide to form gametes, each resulting gamete receives only one member of each chromosome pair. • define fertilization. • recognize that each individual receives one-half of his chromosomes from his father's sperm cell and one-half from his mother's egg. • identify fertilization as the process by which the species number of chromosomes is restored. • identify the chromosomes in a cell resulting from mitotic division as being the same number and kind as that in the original cell.	The hereditary pattern is contained in every cell of an individual and determines the kind of organism the individual will be. The hereditary pattern is coded in structures called chromosomes. Each kind of living thing (species) has its own number of chromosomes. For example, the human cell has 46 chromosomes while the cow cell has 60 and the corn cell has 20. Chromosomes occur in pairs in most body cells. Human cells have 23 pairs while cow cells have 30 pairs and corn cells have 10 pairs. When cells divide to form gametes (reduction division or meiosis) each resulting gamete receives only one member of each pair of chromosomes present in the original cell. Fertilization is the combining of the chromosomes of the sperm with the chromosomes of the egg. Each individual receives one-half of his chromosomes from his father by means of the sperm and one-half of his chromosomes from his mother by means of the egg. The species number of chromosomes is regained during fertilization. The chromosomes will again be in pairs.	Suggested motivation: Bring to class a litter of rats and litter of mice together with their mothers. Place the adult female mouse with the litter of rats in a single cage. Separate the adult from the young by means of a partition. Do the same with the female rat and the litter of mice. (If rats and mice are not available, use combinations of any suitable mammal or tropical fish.) What mistake has been made in housing these animals? How do you know that a mistake has been made? Elicit that parents give rise to their own kind of offspring (unless artificially implanted). What determines whether the offspring will be a rat, a mouse, a human, or a maple tree? Show, by means of an overhead projector or charts, pictures of the chromosomes in a human cell and in a fruit fly cell. State that the hereditary pattern is contained in every cell of an individual and is coded in the chromosomes. Elicit that: each kind of living thing (species) has its own number and kind of chromosomes; chromosomes occur in pairs in most body cells.	Discuss the misconception that "good blood" and "bad blood" are responsible for a person's characteristics. Use felt boards or magnet boards to demonstrate the process of mitosis, reduction division, and fertilization. Diagram 8-1 **Fertilization**  Examine prepared slides of *Ascaris*, whitefish blastula, and onion root tip to see cells in the process of mitosis. Using pipe cleaners or clay, have pupils recreate the processes of mitosis, reduction division, and fertilization. Show pictures of chromosomes and cell division. Bring in IBM punch cards to show concept of "coding." Bring in an example of a code.

In ordinary cell division (mitosis) each resulting cell receives the same number and kind of chromosomes as the original cell.

How do the parents pass on the hereditary pattern to their offspring?

Elicit that the only parts of the parents that become part of the offspring are the sperm and the egg, and therefore these gametes must contain the hereditary pattern in the form of chromosomes. Point out that the sperm and the egg must contain only one-half the species number of chromosomes each, in order for the fertilized egg to have the species number of chromosomes. Emphasize that the sperm and the egg make an equal contribution and that each contributes one member of each pair of chromosomes.

By what special type of cell division are sperm and egg formed from cells in the sex organs? Tell the class that gametes are formed by a special kind of cell division called reduction division or meiosis. During reduction division, members of the same pair of chromosomes separate and go into different gametes. (See *Enrichment* for chart.)

How is the species number of chromosomes restored after reduction division?

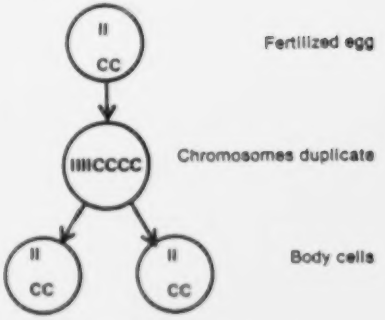
Elicit that fertilization restores the original number of chromosomes and results in the pairing of similar chromosomes in the fertilized egg.

How do the body cells that develop get a copy of the hereditary pattern from the fertilized egg?

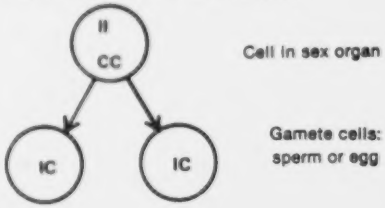
Develop the concept that the fertilized egg divides by mitosis to form the body cells and during this process the chormosomes duplicate and a copy of each chromosome (both members of each pair) is given to each new cell. (See Enrichment for chart.)

Diagram 8-2

Mitosis



Meiosis (Reduction Division)



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Topic B: *How are our traits coded in the chromosomes?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • define a trait. • relate traits to codes in chromosomes. • identify DNA as one of the chemicals from which chromosomes are made. • recognize that DNA is made up of four different paired groups of chemicals that can be put together in many different orders. • relate the way the hereditary pattern in the chromosomes is coded to the order in which the four different pairs are put together in DNA. • define gene. • relate the way a gene operates to the production of an enzyme.	A trait is a characteristic of plants and animals, *e.g.*, size, shape, eye color, hair color. Traits are coded in the chromosomes. DNA (deoxyribonucleic acid) is one of the chemicals from which the chromosomes are made. The DNA molecule is basically made up of four different paired groups of chemicals. These four basic pair can be put together in many different orders. The hereditary pattern in the chromosome is coded by the order in which these four pairs are put together in DNA. A gene is that part of a chromosome that controls a single trait. The coded DNA making up each gene is believed to operate by causing the production of an enzyme. Enzymes can bring about many changes in the structure and function of the body.	Suggested motivation: On a transparancy for an overhead projector, make two simple blueprints of two houses. (See Diagram 8-3.) If you handed one of these blueprints to a builder and asked him to build a house, how would he know what the house should look like? Develop the concept that the blueprint is a pattern of a structure to be built. The information needed for building is "coded" by means of lines and numbers in the blueprint. How could you tell these houses apart after they were built? Elicit that each of these houses has certain definite characteristics. What characteristics do we have that enable us to recognize each other? Elicit that these characteristics are called traits. How does the body know how to build itself? Elicit that the only materials we received from our parents were the sperm and the egg containing chromosomes. Therefore, the hereditary pattern must be in the form of a code.	Construct simplified DNA molecules using various media. Use IBM cards to show the concept of coding. Test for the difference in the starch-synthesizing enzyme found in wrinkled and smooth peas. Place a drop of extract from each type of pea on glucose-1-phosphate agar (obtainable from Diffco and Baltimore Biological Laboratories). Wait one-half hour and place a drop of Lugol's iodine solution on each of these spots. The wrinkled pea extract contains a greater concentration of starch-synthesizing enzyme and will result in a deeper blue color. Using a microscope, examine the starch grains in the scrapings collected from smooth and wrinkled peas. The difference in enzyme content is expressed as a distinct difference in the appearance of the starch grains. Starch grains from smooth peas are smooth and oval; those from wrinkled peas are spherical and have grooves. Contrast a strand of cotton with a piece of cotton cloth to show that the strand (DNA) is part of the whole (chromosome).

Bring in the Watson-Crick DNA molecule model and tell the class that scientists have found out that chromosomes contain long molecules called DNA (deoxyribonucleic acid) and elicit that the information must be coded somehow in the DNA.

Have the class examine the DNA molecule. Ask what parts seem to be repeated over and over again?

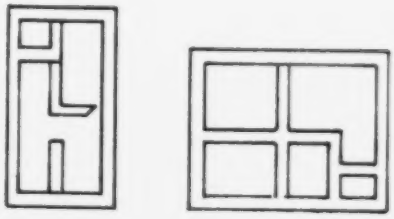
Elicit that a DNA molecule is basically made up of four paired chemical groups that are repeated. These four paired groups of chemicals have names which may be abbreviated by letters in the same way that we use initials to abbreviate our own names. These paired groups are abbreviated as:

T-A	G-C
A-T	C-G

Distribute to committees four cards or blocks containing the above letter combinations. Tell the class that scientists believe that groups of only three pairs are used as "words" in the code. Ask the committees how many three pair combinations they can make. Elicit that it is possible to make many combinations that can be used in a code.

Explain that scientists believe that the "code" is used by the body for the production of enzymes and these enzymes can bring about many changes in the structure and function of the body. For example, although we all have the proper raw materials to make melanin, the brown pigment in our eyes, only those people who have the "code" for the proper enzyme can put together these materials and thus have brown eyes.

Diagram 8-3



Topic C: *Why do we have some traits from our mother and some traits from our father?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • relate each trait to the presence of two genes. • identify these two genes as being located on a pair of similar chromosomes — one of which came from the mother and the other from the father. • contrast an individual who is pure for a trait with an individual who is hybrid for a trait. • contrast dominant and recessive traits. • recognize that if both parents are pure for a trait, the offspring must be pure for the trait. • recognize that the recessive trait that is hidden in hybrid parents can appear in some of their offspring. • identify a person with a recessive trait as one who is pure for that trait. • use the Punnett square method for studying genetic crosses to predict possible offspring.	We have two genes for each trait. These two genes are located on a pair of similar chromosomes, one of which came from the father and the other from the mother. A person is pure for a trait if he/she has both like genes for the trait. For example, two genes for blue eyes. A person is hybrid for a trait if he/she has unlike genes for that trait. For example, one gene for blue eyes and another gene for brown eyes. If a person is hybrid for a trait, usually only one of the genes determines the trait. The trait that appears is called dominant. The trait that is hidden is called recessive. If two parents are pure for the same trait, the offspring must be pure for that trait. If two parents are hybrid for a trait, the recessive trait that was hidden in the parents can reappear in some of their offspring. A person who has the recessive trait must be pure for that trait.	Suggested motivation: Ask the class how many know of two brown-eyed parents that have a blue-eyed child. Establish that this situation can exist and put a diagram of such a family tree on the board. How did the child get any genes for blue eyes? Elicit that at least one of the parents must have had a gene for blue eyes, but since that parent has brown eyes, the parent must have at least one gene for brown eyes also. How many genes do we have for eye color? Emphasize that in most cases there are two genes for every trait. We receive one gene from our mother and one gene from our father as part of the similar chromosomes that paired up in the fertilized egg. Elicit that if both genes are the same, the person is pure for that trait and if both genes are unlike, the person is hybrid for that trait. Referring back to the family tree, ask the class: What color are your eyes if your are hybrid for blue eyes and for brown eyes?	Identify pupils with attached and pupils with unattached earlobes. Establish which trait is dominant, based on frequency of occurrence. (Most pupils should have unattached ear lobes.) Establish that a dominant trait usually has the greater frequency of occurrence. Contrast the above statement with the frequency of five-finger inheritance. (Although six-finger polydactyly is the dominant trait the gene is not common because it is selected against.) Bring in family trees with blank boxes and circles. Ask the pupils to predict the traits of the parents when given the traits of the offspring and vice versa. Bring in fruit fly cultures with white and red eyes. These traits can be seen microscopically or with a hand lens. Mate several of the flies and bring the results back to class. Have the class determine which trait is dominant and which is recessive. Mate vestigial-winged male fruit flies with normal-winged female fruit flies. Also mate normal-winged males with vestigial-winged females. Bring the results to class and note that usually it makes no difference in the offspring whether the dominant trait came from the male or from the female.

Elicit that when a person is hybrid for a trait, usually only one of the genes determines the trait. The trait which appears is the dominant trait, and the one which does not appear is the recessive trait. Therefore, a person who shows a recessive trait must be pure because if he were hybrid, he would display the dominant trait.

Demonstrate the use of the Punnett square to show possible combinations resulting from a cross of two organisms.

Laboratory experience:

Students use the Punnett square method to predict the possible offspring from a series of crosses.

Develop the concept of pedigree, or family tree. Have the students enter information on traits, which can be discussed either orally or in writing.

Topic D: *How can our mothers and our fathers both contribute to the same trait?*

Performance Objectives

The student should be able to:

- recognize that sickle-cell anemia is an inherited disease in which hemoglobin is not normal.
- define anemia.
- recognize the cause for the "blending" of traits.
- identify the inheritance of human blood type as an example of both blending inheritance and complete dominance.
- identify the three genes that control blood type.
- recognize that the genes for type A and type B blood blend to produce type AB blood and that both genes are dominant over the gene for type O blood.
- identify three human traits that are not clear-cut cases of blending or complete dominance because they are controlled by several pairs of genes.

Understandings

Sickle-cell anemia is an inherited disease in which the hemoglobin of the red blood cell is not normal.

Hemoglobin is needed to carry oxygen to our cells. Any condition in which we do not have enough normal hemoglobin to do this properly is called anemia.

If the person is pure for sickle-cell anemia because both genes are present, all of the hemoglobin is not normal and the red blood cells take on a curved (sickle) shape. Such a condition results in death.

If a person is hybrid for sickle-cell anemia, only about half of his hemoglobin is not normal and the red blood cells take on a less curved (sickle) shape. This is true because neither normal nor sickle-cell anemia is a dominant trait. Therefore, a milder type of anemia results.

In some cases of heredity, neither trait is dominant. In such cases, the traits blend.

Human blood type is both an example of blending inheritance and complete dominance.

There are three types of genes that control blood type, A, B, and O.

Suggested Procedures

Suggested motivation:

Prepare an overhead transparency showing the various shapes of red blood cells associated with sickle-cell anemia.

Inform the class that a disease called sickle cell anemia was found to be common among people in certain parts of the world, particularly among people in Africa. Investigations have revealed that it runs in families. How can you account for this? Elicit that this disease is inherited by means of a gene.

Microscopic examination of the blood revealed that in severe cases where the person died, the red blood cells took on a curved (sickle) shape. In mild cases, the blood cells were less curved.

Show the above described transparency.

Scientists have discovered that none of the hemoglobin contained in the red blood cells of severe cases was normal. Why would this cause a person to die? Recall the function of hemoglobin and develop the idea that in any anemia there is a lack of normal hemoglobin. Why don't people with mild cases of sickle-cell anemia die? Develop the idea that there must be enough normal hemoglobin in mild

Enrichment

By means of charts of four o'clock flowers, Andalusian fowl, and roan cattle, explain blending inheritance.

Discuss the relationship between sickle-cell anemia and the resistance to malaria. Account for the survival of the gene in spite of the fact that it causes a serious disease.

Develop that the various blood types are determined by the hereditary patterns as follows:

Blood Type	Gene Combinations
A	AA or AO
B	BB or BO
AB	AB
O	OO

Present the problem:
Suppose two newborn babies were accidentally mixed up in a hospital. In an effort to decide to which parents each baby belonged, the blood types of the babies and the parents were determined:

Baby 1	Type O
Baby 2	Type A
Mrs. Brown	Type B
Mr. Brown	Type AB
Mrs. Smith	Type B
Mr. Smith	Type B

Determine which baby belongs to which parents, and the gene makeup of each person. Use the Punnett square method.

Genes A and B blend and produce type AB blood. However, either A or B is dominant over O.

Some traits in human beings are controlled by several pairs of genes. As a result, clear-cut cases of blending, dominance, and recessiveness are not common. For example, skin color, hair color, eye color, and height.

cases so that the cells are supplied with oxygen. In mild cases, about one-half of the hemoglobin is normal and about one-half is sickle-cell hemoglobin.

How can a microscopic examination tell whether the anemia is severe or mild? Point out that in mild cases, the shape of the red blood cell is intermediate between normal and severe.

Ask:
Why do you think that the shape of the red blood cell and the amount of normal hemoglobin in mild cases is intermediate between normal and severe? Develop the idea that a person with the mild case has only one gene for sickle-cell anemia and is hybrid. (The person with the severe case has two genes for sickle-cell anemia and is pure for that trait.)

How does being hybrid for sickle-cell anemia differ from being hybrid for eye color? Develop that in sickle cell anemia neither the normal nor the sickle cell anemia gene is dominant. This is an example of blending inheritance.

Explain that the inheritance of blood types is dependent upon the presence of any two of three possible genes, namely A,B, or O, and ask: Why is blood type AB an example of blending inheritance?

Why isn't there an AO blood type if a person has genes for A and O?

Why can't we explain the inheritance of other human traits as clear-cut cases of dominance and blending?

Blend red and white tempera to produce pink to demonstrate that both traits "mix" to produce the blended trait.

Topic E: *How is our sex determined?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • compare and contrast the 23 pairs of chromosomes found in the body cells of the male and the female. • identify the twenty-third pair as the sex chromosomes which determine the sex of the individual. • differentiate between a male and a female in terms of their respective chromosome makeup. • compare the gametes formed by males and females as to the presence of X or Y chromosomes. • identify the time of fertilization as the moment when sex is determined. • relate genes on the X chromosome to the inheritance of sex-linked traits. • identify the male as having sex-linked traits more often because there are no dominant normal genes for traits on the Y chromosome. • identify two sex-linked traits (hemophilia and red-green color-blindness). • predict the possible inheritance of sex-linked traits.	Of the 23 pairs of chromosomes in a human cell, 22 pairs are similar in appearance in males and females. The chromosomes in the twenty-third pair are called the sex chromosomes and determine the sex of the person. In females, both chromosomes in pair 23 look the same and are called X chromosomes. In the male, the chromosomes in pair 23 do not look the same and are called the X and the Y chromosomes. A male produces two kinds of sperm in equal numbers, X and Y. A female produces only X eggs. Sex is determined at the time of fertilization. An XX fertilized egg produces a female and an XY fertilized egg produces a male. The Y chromosome contains few or no genes. Traits whose genes are on the X chromosome are said to be sex-linked. Most sex-linked traits are recessive; therefore they show up more often in males because there are no dominant normal genes on the Y chromosome to hide them.	Suggested motivation: Show pictures of Drosophila male and female chromosomes. What difference do you notice in the chromosomes of the male and female fruit fly? Elicit that one of the pairs in the male consists of chromosomes that do not look alike. Point out that one of the dissimilar chromosomes in the male is similar to one pair in the female. The one chromosome in the male that is similar to the two in the female is called an X chromosome and the other is called a Y. Therefore, the female has two X chromosomes and the male has an X and a Y. Show a picture of male and female human chromosomes. Elicit that there are 22 pair and one pair of sex chromosomes. Point out that, here again, there are a pair of X chromosomes in the female and an X and a Y chromosome in the male. How do you get your sex chromosomes? Develop that one comes from the sperm and the other from the egg. Why does the father determine the sex of the offspring? Review that eggs and sperm are produced in reduction division. During reduction	Diagram sperm and egg reduction division and show how the male's sex chromosome determines sex. Place on the chalkboard: Male: XY, X + Y, (Sperm) Female: XX, X + X, (Eggs) Combinations: Sperms + Eggs = Offspring X + X = XX (female) X + Y = XY (male) Show how to work out problems in sex-linked inheritance by means of the Punnett square. Bring in charts for determining color-blindness. Discuss the high frequency of hemophilia in the royal families of Europe and point out the dangers of marrying close relatives. Bring in charts showing the sex-linkage of white eyes in fruit flies. Mate red-eyed female fruit flies with white-eyed males. Show that white eyes are sex-linked. Discuss baldness as a sex-limited trait, not sex-linked. In a sex-limited trait, the presence of hormones influences expression of the gene.

Some sex-linked traits are hemophilia (a bleeding disease) and some types of red-green colorblindness.

division, one member of each pair of chromosomes goes into a different gamete. Therefore, the female produces only X-type eggs while the male produces X and Y sperm in equal numbers. Sex is determined at the time of fertilization and depends on the type of sperm that fertilized the egg.

Project a transparency showing the distribution of hemophilia among Queen Victoria's descendants. Which sex suffers from hemophilia? From which parent does the son receive the disease? Develop that males receive the gene only from their mothers, therefore, it must be carried only on the X chromosome. Tell the class that the gene for hemophilia is recessive to the normal gene.

If the gene for hemophilia is carried on the X chromosome, why don't females usually have the disease? Develop that the recessive gene for hemophilia is hidden by the dominant normal gene carried on the other X chromosome in a female. Tell the class that the Y chromosome carries few or no genes.

Why do males suffer from the disease? Develop that a male who has a gene for hemophilia on his X chromosome does not have a normal gene on his Y chromosome to hide it.

What other trait is sex-linked?

Tell the story of Morgan and his work with fruit flies.

Discuss the advantages of using fruit flies in heredity studies.

Discuss the chance factor of getting a male vs. female offspring.

Discuss the difference between identical vs. fraternal twins.

Topic F: *How can new traits come about?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● define mutation. ● relate mutations to a change in the coding of the chromosomes. ● relate a mutation to the appearance of a new trait. ● recognize that many mutations are harmful but recessive. ● recognize that traits resulting from gene mutation do not appear until two genes for the recessive trait come together. ● identify five causes of mutations. ● recognize that mutations are constantly taking place, but only mutations occuring in sex cells can be passed on to offspring. ● relate the inadvisability of near relatives marrying to the possibility of having genes for the same harmful mutations. ● identify two types of birth defects caused by mutation.	A mutation is a change in the hereditary pattern. Mutations are caused by a change in the coding or a rearrangement of the chromosomes. A mutation results in the appearance of a new trait. Many mutations are harmful but recessive. Traits produced by most mutations do not appear until two genes for the recessive trait come together. The following may cause mutations: radiation such as x-rays, radioactivity, cosmic rays and ultraviolet light, and various chemicals. Our body cells are constantly being exposed to radiation and mutations are constantly taking place. Only mutations in the sex cells are passed on to the offspring. It is not advisable for near relatives to marry because they might have the same harmful mutations. Mutations are responsible for some birth defects such as Down's syndrome, PKU (phenylketonuria), and heart and circulatory defects.	Suggested motivation: Why is worldwide opinion against testing atomic weapons? Develop that atomic testing results in radioactive fallout (radiation) and that radiation can change the DNA code or rearrange the chromosomes in our hereditary pattern. What effect would a change in the hereditary pattern have upon the individual? Develop the concept that a change in hereditary pattern in a body cell may not have any visible effect but a change in a sex cell may result in the appearance of a new trait. This change in the hereditary pattern is called a mutation. Explain to the class that the United States dropped atomic bombs in Hiroshima and Nagasaki in 1945. Medical teams of the United States have been studying the mutations that have resulted. What kinds of mutations have they reported? (Birth defects, for example, and heart and circulation defects.) Develop the concept that most mutations are harmful. Why do we expect to keep our medical teams in Japan indefinitely? Although most mutations are harmful, they are also recessive. Therefore a mutation will not appear as a trait in a person until two recessive genes for	Show pictures of examples of mutations in humans and other plants and animals. Show pictures of chromosome damage due to radiation. Show pictures of the triploid nature of the twenty-first pair of chromosomes as related to Down's syndrome (available from the National Foundation-March of Dimes). Assign reading lessons on birth defects using pamphlets available from the National Foundation-March of Dimes. Discuss the work of Nobel prize winner Herman Muller. Relate it to his work of producing mutations by means of x-rays. If all of the people with serious inherited defects did not have children, why would it still be impossible to wipe out the defects? Why does the "space suit" protect the future children of the space explorer? What precautions should be taken related to the use of x-rays?

the mutation appear in the same individual. Also, this may take many years or never actually happen.

Why would we have mutations even if atomic bombs were banned? Develop that we get mutations at a lesser rate from other sources of radiation such as cosmic rays, x-rays, natural radioactivity, and ultraviolet light. Contact with certain chemicals also causes mutations (formaldehyde, colchicine, mustard gases).

Why are the chances good that all of us have some harmful, recessive genes? Elicit that we are constantly exposed to natural sources of radiation.

Why do modern as well as primitive societies prohibit close relatives from marrying? Develop the concept that the harmful recessive genes that we have will not appear as a trait unless two such genes come together in a single individual. It is important to marry someone who does not have the same harmful recessive gene as you. The chances are very good that close relatives might have the same recessive gene that was inherited from a common ancestor. Even primitive societies observed that children resulting from the marriage of close relatives had defects more frequently and special taboos existed against such marriages.

Why is it possible for birth defects to appear even if close relatives do not marry?

Develop that there are some widespread harmful mutations, for example PKU. (PKU is an inherited defect involving incorrect metabolism of amino acids. It results in severe mental retardation.) Because this gene is so widespread, a law requires that all newborn babies in New York State be tested for PKU. If PKU is detected before the third month, it can be treated.

Why is there a world ban against the use of poisonous gases (mustard gases) in warfare?

Why are some people concerned about living near nuclear power plants or microwave antenna installations?

Topic G: *How does environment affect our traits?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that our heredity pattern merely limits the possibilities of what we can become. • recognize the importance of the environment in enabling us to reach these limits. • list four conditions that make up our environment. • recognize that since we cannot improve our hereditary pattern we should at lease improve our environment. • list five areas for improvement in our environment.	Our hereditary pattern merely limits the possibilities of what we can become. Our environment is important in enabling us to reach these possibilities. The conditions that exist inside and outside of our bodies, such as food, air, temperature, and chemicals, make up our environment. Since we cannot improve our hereditary pattern, we should at least improve our environment so that we develop to our fullest possibilities. Areas for improvement in our environment include: housing, nutrition, labor conditions, health, economic security, and education.	Suggested motivation: Scientists report that on the average we are one inch taller than our parents. Why should this be if we received our genes for height from our parents? Develop the concept that the hereditary pattern determines the limit of our potential. However, the proper environment (define environment) must be present if this limit is to be reached. In the early 1960s pregnant women had been taking a sleeping pill which contained the drug thalidomide. These women gave birth to babies with serious defects such as "seal limbs" (the hands and feet are like flippers, attached close to the body, with little or no arm or leg. Point out that these babies were born with a normal hereditary pattern and therefore the potential for being normal babies. Why didn't the babies fulfill their potential? Why is it difficult to set up an experiment to test the effects of environment on the hereditary pattern? Develop that at least two people with the same hereditary pattern are required and that no two people except identical twins have the same hereditary pattern. Identical twins have the same hereditary pattern	Discuss the use of amniocentesis and ultra sound tests in detecting genetic disorders before the baby is born. Talk about famous families such as the Jukes, Kallikaks, Darwins, and Roosevelts. Discuss the roles that environment and hereditary pattern have played in family traits. Bring in pictures of thalidomide babies. Discuss the value of the "Head Start" program for prekindergarten children.

because they develop from a single fertilized egg. Fraternal twins may not be used because they develop from two separate fertilized eggs.

Records have indicated that some identical twins were separated at birth and raised in different environments. In what ways would you expect they might be different? How will they be alike?

Point out that usually such twins differed in type of work, interests, personality, emotions, and other social traits. They were similar in such physical traits as eye color, nose shape, and number of fingers. However, where one of the twins was exposed to a disease, even the physical traits such as height were different. Point out that a noninherited disease is part of the environment.

Discuss the following data (from Newman's 1919 study of identical twins reared apart): What do such studies show?

	IQ	Vocabulary	Personality
City-bred	99	12,060 words	Dignified, less friendly, more serious
Country-bred	101	10,260 words	Seeks friends less dignified, laughs readily

Have panel discussions of the value of:

a) slum clearance
b) compulsory education laws
c) child labor laws
d) improved working conditions
e) compulsory vaccinations

In view of the fact that a chromosome is microscopic and its structure is very complicated, it would be difficult to change the hereditary pattern of an individual.

How can we ensure that this individual will develop to the limit of his potential? (Improve the environment.)

How may the environment be improved?

Topic H: *How can genetic engineers change genetic codes?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: ● recall that DNA is the material that directs the manufacture of materials by a cell. ● relate the cell's ability to change the materials it makes to the addition to or deletion of parts of its genetic code. ● recognize that recombinant DNA is made up of DNA that came from different organisms. ● recognize that genetic engineering involves artificial processes that affect the genetic material of an organism or its offspring. ● identify cloning as the artificial production of organisms that have the same genetic makeup.	DNA directs the manufacture of materials by the cells. Scientists can change the materials that a cell makes or cause it to make new materials by adding or taking away parts of the genetic code. Recombinant DNA is made up of DNA from one organism added to the DNA of another organism. Genetic engineering involves artificial processes that affect the genetic material of an organism or its offspring. Cloning is the artificial production of organisms that have the same genetic makeup.	Suggested motivation: Recall that diabetics are unable to produce enough insulin in their pancreas. Elicit that treatment consists of giving diabetics insulin that has been obtained from animals from the slaughterhouse. Ask the class what causes this animal insulin to be different from human insulin. Elicit that the genetic codes for insulin production in these animals is different from that in humans, and that some diabetics are allergic to this animal insulin. How might we get non-insulin producing organisms to produce human insulin? Elicit that this can be done by giving them the genetic code for human insulin. Ask the class why bacteria were selected to produce large quantities of human insulin rapidly. (Scientists selected bacteria as the organism to produce insulin because it can reproduce every 20 minutes.)	Discuss how bacteria are being used to bring down the cost of interferon. Discuss the use of bacteria to produce human growth hormone (HGH). Describe the technique by which genes are "snipped off" by enzymes and spliced onto plasmids inside of bacteria. Discuss tissue cultures as related to cloning.

Briefly explain that scientists use enzymes to cut off small sections of DNA from one organism and put it into a bacterium. This fragment of DNA combines with the bacterial DNA. The new strand of combined genetic material is called recombinant DNA.

Elicit from the class a definition of genetic engineering.

Elicit from the class ways in which genetic engineering can be used to benefit mankind.

Ask the class what some of the negative aspects of genetic engineering are (genocides, virulent organisms, etc.).

Unit 9: *How Have Living Things Changed?*

Topic A: How do we know that living things have changed?

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • define evolution. • identify five evidences of evolution and relate each to observations made by scientists. • recognize that living things have changed over a long period of time from simple to complex. • recognize that plants and animals alive today are not the same as the first organisms on earth. • recognize that many species have become extinct and many are being exterminated.	Evolution means gradual change, usually from the simple to the complex, and is still taking place. We know that living things have changed because of the following evidences: **a)** fossils — Fossils are the remains of ancient plants and animals usually formed in rocks. **b)** similar structures — Closely related groups of plants or animals have similar structures showing that they evolved from common ancestors. **c)** similar embryos — The embryos of closely related groups of animals have similar development. **d)** vestigial structures — Structures found in living organisms that now have no use but were useful to an ancient ancestor. **e)** geological evidence — Only simple fossils are found in the lowest layers of rock. Complex fossils are found in layers near the top. These evidences indicate that living things have changed from the simple to the complex over a long period of time. The kinds of plants and animals living today are not the same species as the first organisms on earth. Many species of plants and animals that were once alive have become extinct.	Suggested motivation: Bring to class the horse fossil series together with pictures of each horse in the series. Explain to the class that, where the crust of the earth has been undisturbed, the simplest structures were found in the deepest rock and the most complex structures were found in the layers of rock near the surface. What does this collection tell us about the origin of the modern horse? Develop the concept that the horse has undergone a series of slow changes. This process is called evolution. The modern horse did not exist in the past and the first horse-like animal has become extinct. Scientists call such a collection that traces the origin of an animal a *fossil series*. What is a fossil? Show the class examples of fossils. Laboratory experience: Obtain clean, one-gallon plastic jars. Supply the students with a mixture of sand, aquarium gravel, soil, and a little cement. Have the students add a few bones, shells, teeth, stems, leaves, and one-half gallon of water. Students should cap the jar and shake vigorously. After shaking, most of the water is syphoned off and the container is placed on a warm radiator or a sunny window.	Show and discuss how fossils are formed. Illustrate by embedding a shell in salted plaster of Paris, an insect in balsam, or a worm in ice. Also stir up a mixture of sand, gravel, mud, and shells in water to show sedimentation. Discuss the process of petrification. Show pictures of the Grand Canyon and discuss how it was formed. Discuss the origin of the La Brea tar pits and how the fossils were formed. Show pictures of the woolly mammoth and the saber-toothed tiger. Discuss their fossil series. Discuss the origin of coal. Assign reading lesson using the book *Animals of Yesterday,* Row Peterson Series. Trip to the American Museum of Natural History to see fossil series and extinct species. Contact the Education Department for a visit sheet for each hall. Compare vertebrate brains. Take the class for a walk in the neighborhood and identify fossils in stone used in buildings and highway construction.

One or two days later, the students should cut away the plastic container and, using a hacksaw, make cross sectional cuts of the sedimentary rock formed.

The students should look for the implanted remains of life. Through discussion, compare this laboratory experience with the process of sedimentation and fossil formation.

What other proofs are there which show that living things have evolved?

Referring to the skeleton of the leg of the modern horse, point out that the splint bones are not visible on the horse because they are underneath the skin. Ask the class: "How can you account for the presence of the splint bones under the skin of the modern horse?" Develop the concept that the modern horse has inherited this trait from ancestors but no longer uses this structure.

Develop the concept that the modern horse has splint bones because he has a gene for this trait. He still has this gene because it was passed to him from the earlier horse forms even though he no longer uses this trait. However, mutations have changed the trait. Scientists call such structures vestigial structures. Such structures are evidence of evolution because we can follow the passage of a gene from an earlier ancestor to a modern form.

Elicit other vestigial structures in man and other animals.

Show the skeletons of a fish, frog, snake, chicken, cat, and man.

Ask the question: "What evidence is there that all of these vertebrates have some genes that are similar?" Develop the idea that all of these skeletons have similar parts, *e.g.*, a backbone and a skull, and therefore must have similar genes that have produced these similar traits.

How can we account for the presence of similar genes in such different organisms? Develop that these animals must all be related because they got their genes from a common ancestor. Point out that it is possible that the genes got to the mammals via the fish, amphibians and reptiles.

Show the similarity of traits of vertebrate embryos. Develop the concept that all of the forms have almost the same hereditary pattern that determines embryological development. Point out the significance as evidence for evolution.

Show a picture of the Grand Canyon as well as a transparency of the diagram in Appendix 8.

Where are the oldest layers of rock? Elicit that the deepest layers were formed first and are the oldest. More recent layers are on top.

How do the fossils found in the deepest layers of rock compare with the fossils found in the more recent layers?

Point out that only simple fossils are found in the deepest layers and complex fossils are found only in the more recent layers at the top. What does this tell us about the order in which simple and complex living things evolved?

Point out that simple plants and animals appeared on the earth before the complex forms of life.

What does this tell us about the general pattern of evolution?

Elicit that living things usually evolve from the simple to the complex.

In which layer of rock in the diagram would you expect that fossils of dinosaurs were found? Develop that dinosaurs were reptiles and therefore would be found in the layer of rock in which reptiles first appeared.

Why aren't dinosaurs found in the rock layer containing fossils of mammals and birds?

Develop that species within a major group may become extinct even though the group continues. For example, the presence of living snakes and turtles indicates that the reptile group has not become extinct but the various dinosaur species have become extinct.

Ask:
Why can't we trace the evolution of living things by studying only those species of plants and animals alive today?
(Scientists presume that every living species evolved from a species that lived before and therefore no species alive today is identical to the species that existed when life began.)

Why would you find fossils of reptiles in the layer with mammals and birds?

Elicit that some reptiles are still alive today and therefore probably existed ever since they first appeared on the earth.

Topic B: *How have humans evolved?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize that humans, like other organisms, have evolved through the ages but that the fossil series is incomplete. • recognize that humans and apes probably evolved from a common ancestor. • recognize that evolution in humans and other organisms is not a straight-line process and is still going on. • identify all living humans as belonging to a single species, *Homo sapiens sapiens.* • identify three major human stocks. • recognize why millions of people are not of one stock.	Humans, like other living things, have evolved through the ages. We have relatively few fossils of humans, therefore this fossil series is incomplete. Humans did not descend from the ape, but both descended from a common ancestor. Evolution in humans, as with other plants and animals, did not occur in a straight line from a primitive ancestor but rather there were offshoots from the main line. Evolution is an ongoing process. All living humans are similar enough to belong to a single species, *Homo sapiens.* Most living humans are divided into three major stocks: Caucasoid, Mongoloid, and Negroid. Because of migration, people of different stock have met, married, and interbred. Thus millions of people are not truly of one stock.	Suggested motivation: Show 2-by-2 inch slide series, *Ancient Man,* available from the American Museum of Natural History, or show pictures of prehistoric men. What similarities do Java Man, Neanderthal Man, Cro-Magnon Man and modern man have in common? What evidence is there that man may have evolved from species that are related to these prehistoric men? Point out that although modern humans have many similarities to the fossils of prehistoric man that have been discovered, there are enough differences to indicate that we did not evolve directly from any one of them but rather from "missing" forms that were related to them. Why doesn't this fossil record show the gradual evolution of modern humans as clearly as the horse series shows the gradual evolution of the horse? Develop the idea that the fossil record of humans is very incomplete because humans were wise enough to avoid conditions which would fossilize them. In addition, human tissue decays rapidly in the soil.	Present the statistics of the cerebral capacity of prehistoric man, modern man, and the modern ape. Show pictures of cave drawings and artifacts of primitive man. Make a class trip to the American Museum of Natural History to see the evolutionary tree of modern man. Pupils may write essays on the cultural achievements of different stocks. Discuss the effect of the domestication of wild animals on the civilization of man. Discuss possible future evolutionary trends of modern humans. Assign reading lesson using material on human stocks. Display photographs showing some of the small differences in human beings, such as skin, hair color, shape of facial bones, hair texture, and folding of skin around the eyes. Discuss how skin color could serve as an adaptation for life in specific environments.

Show pictures of the three stocks, Caucasoid, Mongoloid, and Negroid. Ask: "What basic similarities make them members of one species?" Point out that the four basic blood types are present in each one of these stocks. Also their bodies contain the same organs and function the same way. Elicit that all living humans are similar enough to be placed into a single species called *Homo sapiens sapiens.*

Why is it wrong to say that humans evolved from the ape? Develop the idea that humans and apes probably evolved from a primitive ancestor. The evolutionary pathway from this ancestor divided, one branch leading to modern humans and the other branch leading to the apes. The branch leading to modern humans gave rise to side branches which resulted in the prehistoric men we have discovered as fossils. This branched pattern is typical of the evolution of all species of plants and animals. Point out that evolution in all plants and animals is continuous.

Assign reports on *Australopithecus africanus, Homo habilis, Homo erectus,* and *Homo sapiens neanderthalensis,* as each compares with *Homo sapiens sapiens.*

Anthropolgists now classify *Homo sapiens* into 5 forms or races:

Europiform
Mongoliform
Negroform
Khoisaniform
Australiform

Topic C: *How have living things become adapted to live successfully?*

Performance Objectives	Understandings	Suggested Procedures	Enrichment
The student should be able to: • recognize natural selection as the mechanism used by Darwin to explain evolution and adaptation. • recognize that other scientists have added their findings to Darwin's theory. • arrange in sequential order the five factors in Darwin's theory. • relate the five factors to specifically described situations. • relate mutation and natural selection to the method by which organisms become adapted to their environment.	Darwin's theory of evolution by means of natural selection helps explain the way living things change. It also helps to explain why living things seem to fit in perfectly with their environment. This theory is one of the most important theories in science. In addition to Darwin, many people have contributed to a better understanding of how evolution takes place. The modern theory of evolution based upon Darwin's theory includes the following: *Overproduction* — Each species produces more offspring than can possibly survive. *Variations* — Mutations produce differences in traits among the members of the same species. *Struggle for existence* — Since the environment cannot support all of the offspring that are produced, there is a struggle to remain alive. *Survival of the fittest* — Those individuals that have mutations which make them better suited to the environment live longer and pass these traits on to their offspring. These offspring have a better chance of survival than other members of the same species which do not possess the traits.	Suggested motivation: Bring to class any insect that shows protective coloration or mimicry, for example, the walking-stick, the praying mantis, the viceroy and monarch butterflies. Ask: "How did this insect become so perfectly fitted to his environment?" Have pupils list possible reasons. Present the following problem: In the area of White Sands, New Mexico, the earth has turned white in a recent geologic time. Animals that live in this area are also white in color. Scientists have discovered fossils which show that members of these same species were the same color as is now found in the area outside White Sands. They also found that these fossils were alive before the earth of White Sands turned white. How would you account for the fact that the animals in White Sands are white, while those found outside the area are of normal color? Develop the idea that at one time the earth of White Sands was the same color as the surrounding area. At this time the color of the animals that inhabited White Sands was the same as the color of the animals in the surrounding area. Any animal that had a mutation for white color would not live long enough to have many offspring because it would stand out against	Write a few paragraphs describing the evolution of the dark-colored peppered moth in England. Have students answer questions dealing with the mechanism by which change took place. Bring in Riker mounts of organisms showing protective coloration. Discuss the experiments with buff and gray deer mice as conducted at the University of Michigan. Discuss the role of natural selection in producing immunity in flies to DDT. Inoculate a Petri dish containing nurient agar with nonpathogenic bacteria that is resistant to penicillin. Place penicillin antibiotic disc at the center of the dish. Point out the presence of small colonies within the zone of inhibition. Use the theory of natural selection to explain their presence. Relate this to the danger of *Staphylococcus aureus* infections in hospitals and the inadvisability of administering antibiotics indiscriminately. Show a transparency of Darwin's finches and discuss the reason for survival of a particular beak shape as related to the environment.

Inheritance of favorable traits — The offspring of those individuals with the favorable mutation inherit this favorable trait and also have an advantage over the others that do not have this trait. They will also live longer and produce more offspring like themselves.

Evolution of a new species — Eventually most of the members of the species will have new, favorable traits. In time, these individuals may be so different from those who have not changed that a new species is formed.

Natural selection serves to adapt living things to a changing environment.

the dark soil. However, after the soil turned white, any animal with the mutation for white color would have the advantage of protective coloration. Thus white animals lived longer and had more offspring than the darker animals. Their offspring had the same advantage because they inherited the favorable mutation. Eventually whole new species of white animals evolved.

Using the events in White Sands, New Mexico, develop the important steps in the modern theory of evolution. (Overproduction can be elicited by means of a discussion of the number of eggs produced by the salmon.)

Topic D: *How did life begin?*

Performance Objectives

The student should be able to:

- relate the formation of the earth about 4½ billion years ago to the presence of cosmic dust.
- recognize that the chemical elements that formed the first living matter probably came from an oxygen-free primitive atmosphere.
- identify the sources of energy probably used to combine these elements.
- relate the first life to groups of proteins and carbohydrates probably formed from atmospheric gases.
- recognize that the first life started in the ocean.
- identify the probable source of energy for the first living things.
- identify mutation and natural selection as the mechanisms by which photosynthetic organisms evolved.
- recognize that the addition of oxygen to the primitive atmosphere enabled different forms of living organisms to evolve (aerobes).
- recognize that modern plants and animals evolved from the first living things by means of mutation and natural selection.

Understandings

Most scientists believe that the sun and the planets, including the earth, were formed by the coming together of dust in space (cosmic dust) about 4½ billion years ago.

Most scientists also believe that life began 3 billion years ago in the following way:

The chemical elements that formed living matter originally came from the gases in the early atmosphere. This atmosphere contained no oxygen.

These chemical elements were combined using energy that came from ultraviolet light, lightning discharges, the earth's heat, and natural radioactivity.

The first life started in the ocean from groups of proteins and carbohydrate molecules that formed from the chemical elements in the atmospheric gases.

The first living things could not make their own food but obtained energy from other protein and carbohydrate molecules around them.

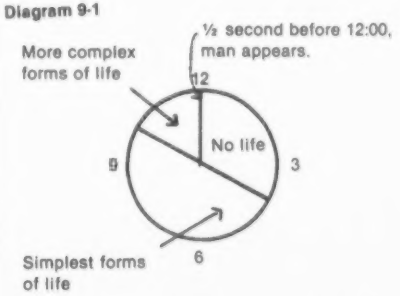
When the supply of food became scarce, those organisms which received the mutation that allowed them to make food using energy from the sun (photosynthesis) had an advantage and increased in numbers. These organisms released oxygen into the atmosphere.

Suggested Procedures

Suggested motivation:

The age of the earth compares to a 12-hour time span on a clock.

Diagram 9-1



How long ago did the earth form? Develop the concept that scientists believe that the earth was formed about 4½ billion years ago. Point out that for about 1½ billion years (about one-third of the earth's existence), there is no evidence that life existed.

What do we believe happened on our earth during the 1½ billion years in which no life existed? Through appropriate reading material, charts, films, filmstrips, slides, etc., develop the concept that scientists believe the following sequence of events occurred:

When it was first formed, the earth was so hot that everything was molten. At this time there was much rain and lightning.

Enrichment

Show the *Life* film strip series *The Origin of the Earth*, or another film on this topic.

Use atomic models to show the concept that atoms join to form molecules.

Discuss the experiments of Miller and Fox, showing appropriate diagrams and pictures.

Discuss why scientists believe that life may exist on planets outside our solar system even though such planets cannot be seen. Point out that if we had our best telescope on the star nearest to our sun, the distance is so great that we would not be able to see the largest planets in our solar system.

Discuss whether or not "life" might be forming on the earth today. Consider such factors as: decreased temperature, ultraviolet light, and cosmic radiation, and the change in atmosphere.

Discuss the meaning of the following poem written by Harold Dorf, a New York City science teacher:

"Cosmic ions from afar,
Born in some gigantic star,
Bumped a strand of DNA
And made us what we are today."

Natural selection favored those organisms that received the mutation which allowed them to release energy from food by means of oxygen.

From these one-celled organisms life sprang in all directions and, by means of mutations and natural selection, resulted in the types of plants and animals we see today.

The earth cooled gradually and the rains no longer boiled off the surface but remained to form warm oceans.

The early atmosphere did not contain oxygen but was made up of gases that contained all the chemical elements needed for life.

Ultraviolet light, lightning, the heat of the earth, and natural radioactivity provided the energy needed to combine the chemical elements in the atmospheric gases.

The rains carried these new chemicals into the ocean where they combined again to form proteins and carbohydrates.

Demonstrate that proteins are sticky by asking a pupil to touch egg albumen. Point out that the protein in milk, casein, is used as glue. How would this characteristic of proteins aid in the formation of a living thing? Have the class speculate that the proteins in the ocean grouped together by chance and thus formed the first simple living thing.

What could these first living things have used for food? Elicit that they could have used the other proteins and carbohydrates in the ocean around them. The first living things probably were using up proteins and carbohydrates quicker than new compounds could form.

What problem would arise under these conditions? How was the problem solved? Develop the idea that when the supply of food became scarce, those organisms which received a mutation that allowed them to make food using energy from the sun (photosynthesis) had an advantage and increased in numbers. These

organisms released oxygen into the atmosphere in much the same way as green plants do today.

Why was the release of oxygen into the atmosphere such an important event?

Develop the theory that it changed the environment in such a way that those organisms which received a mutation which allowed them to release energy from food by means of oxygen could release more energy from their food and thus had an advantage favored by natural selection.

Project a transparency showing the "Tree of Life," and ask: "Where does this first organism fit on the "Tree of Life?" Develop the idea that these first living things form the base of the tree; from these early organisms, life sprang up in all directions and by means of mutation and natural selection produced the types of plants and animals we see today.

APPENDICES

Appendix 1: *Checklist for Superstitions*

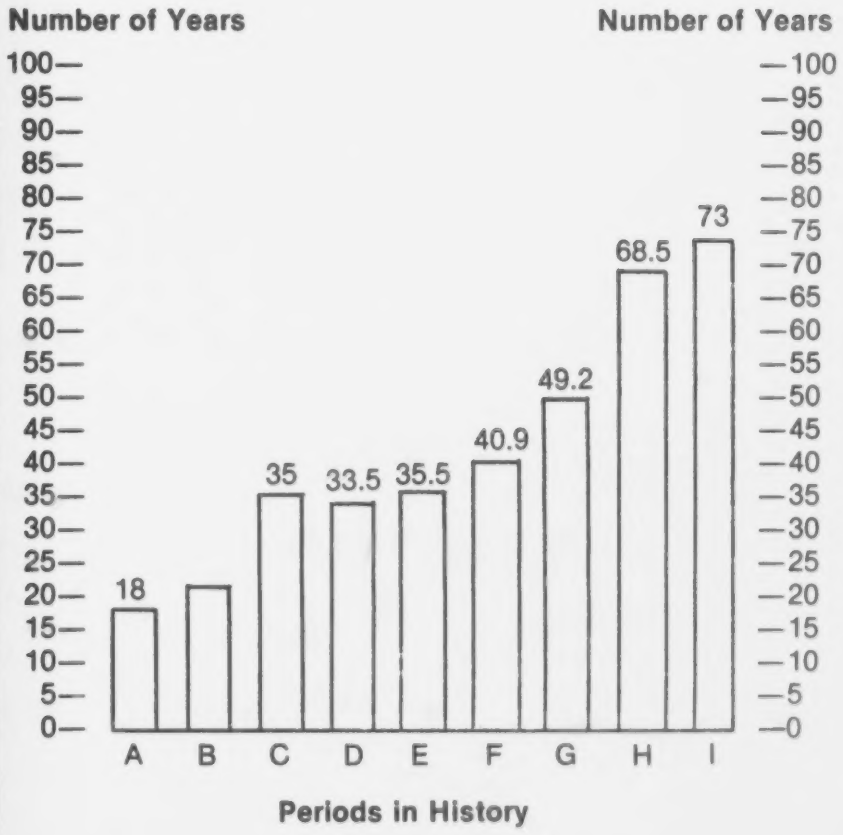
To Pupil: Here are some statements. Read each statement carefully. If you believe the statement is true, draw a circle around the letter *T*. If you believe the statement is not true, draw a circle around the letter *F*.

T F 1. *If you speak of a person, he/she is likely to appear.*
T F 2. *Men are smarter than women.*
T F 3. *Light colored clothes are not usually as warm as dark clothes of the same material.*
T F 4. *A square chin shows that a person has will power.*
T F 5. *Dreams tell what will happen in the future.*
T F 6. *A horseshoe over the door will bring good luck.*
T F 7. *If somebody sneezes when someone has just finished talking, it means the truth was told.*
T F 8. *All snakes are poisonous.*
T F 9. *Handling a toad will make warts grow.*
T F 10. *If you look at the trunk of a tree that is newly cut across, you can tell how old the tree is.*
T F 11. *Wisdom teeth make a person wise.*
T F 12. Your fortune can be told with a pack of cards.
T F 13. *A child's first teeth fall out to make room for larger ones.*
T F 14. *If it rains on St. Swithin's Day (July 15), it will rain on each of the following 40 days.*
T F 15. *Dripping water may wear a stone away.*
T F 16. *Fat people are always good natured.*
T F 17. *If you think too much about a disease, you will get it.*
T F 18. *Some flowers bloom in the fall.*
T F 19. *If the palm of your left hand itches, you will get some money.*
T F 20. *There are witches who can harm people and cast spells.*
T F 21. *A ringworm is a plant that feeds on people.*
T F 22. *A person can be smart and also good looking.*
T F 23. *A genius is always crazy.*
T F 24. *It is best to knock on wood after mentioning your good fortune.*
T F 25. *You can tell if people are good or bad by looking at their faces.*
T F 26. *Eating calf's brains makes a person dull.*
T F 27. *Grown-ups sometimes become stupid because they study too much.*
T F 28. *Eating raisins gives you iron.*
T F 29. *You can tell what people can do best by looking at their handwriting.*
T F 30. *Red will make a bull angry.*
T F 31. *If a bat gets in your hair, you must shave your hair off.*
T F 32. *If a snake is killed, its tail will not die until after sundown.*
T F 33. *All of a hen's eggs can hatch into chickens if the hen is allowed to set on them.*
T F 34. *A bee dies soon after it stings a person or animal.*
T F 35. *If a person's eyebrows meet in front, it is a sign that he/she is of the criminal type.*
T F 36. *Horses see us magnified seven times.*
T F 37. *Stepping on an ant brings rain.*
T F 38. *You can catch a cold by being near a person with a cold.*
T F 39. *Chewing a piece of meat 100 times makes it easier to digest.*
T F 40. *If somebody sings before breakfast, they will cry before night.*

This list was adapted from one originally compiled by the late Ralph Horton of Seward Park High School. A list of this kind can be used to start a discussion of superstitions.

Appendix 2: *Increases in Life Span*

Average Length of Life During Different Periods of History



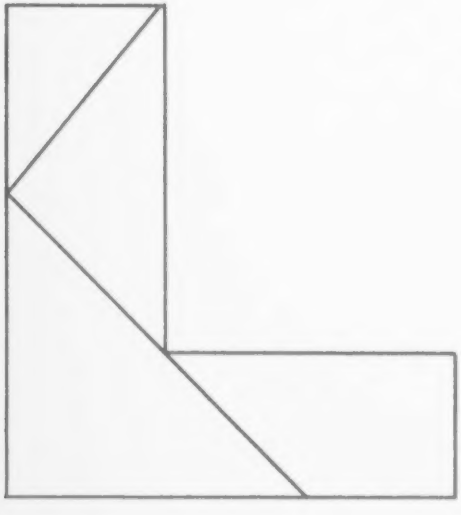
A. 2000 B.C.
B. About 50 B.C.
C. Middle Ages
D. 1687-1691
E. Before 1789
F. 1838-1854
G. 1900-1902 (United States)
H. 1951 (United States)
I. 1983 (United States)

Increase in the average length of life was gradual from ancient to modern times. Note marked jump as a result of recent medical advances.

This chart was adapted from material in Dublin, *et al.*, *Length of Life*, Ronald Press.

Appendix 3: *Letter* L *Puzzle*

Distribute copies of the puzzle, cut as shown, in individual envelopes to each pupil. The teacher announces the time elapsed at intervals of five seconds. Pupils record the time they require to assemble the puzzle for three successive trials.



Appendix 4: *Learning Through Understanding*

Aim: to show the importance of understanding the meaning of material to be memorized or learned, and to show the importance of association in learning or memorizing.

Materials: paper, pencils

Suggested Directions for Students
(These may be mimeographed and distributed to students.)

1. Read through list A carefully three times; then without looking at the list, write down all the items you remember, and put them in the correct order as far as you can remember.
2. Read list B three times and test yourself in the same way.
3. Do the same with list C.
4. Count up your score in each list separately. Count one credit for each item you have remembered.

A	B	C
vip	shoe	away
lor	book	with
zub	grass	recipes
maf	when	in
baz	plane	books
hab	house	hunger
koz	after	is
det	sell	the
bir	dish	best
nem	time	of
caj	fruit	cooks

Summary

1. On which list did you have the highest score?
2. On which list did you have the lowest score?
3. How did the task of memorizing list C differ from that of memorizing list A?
4. How did the task of memorizing list C differ from that of memorizing list B?
5. What have you proved by this experiment?
6. How can the information gained from this experiment be of value to you in your studying?
7. Devise an experiment to determine whether reciting aloud is more effective for you as a method of memorization. Try this experiment with your partner. Tell what you did and what results you obtained.
8. Try to recall the material memorized above after a week has elapsed.

Adapted from *Biology (Regent's Course)*, Board of Education of the City of New York, Brooklyn, N.Y., 1962.

Appendix 5: *Learning Under Distractions*

Aim: to show the effect of noise or other disturbing factors on the ability to learn.

Materials: Phonograph or radio, bell, buzzer, stop watch.

Allow two minutes for each limerick.

Suggested Directions for Students
(These may be mimeographed and distributed to the students.)

Below are three limericks. You are to try to memorize each of these under varying conditions. For each limerick, the teacher will give the signal for you to begin and to stop. After you have practiced memorizing the first limerick and the signal to stop has been given, write down as many lines as you can remember without referring to this sheet. Score your results by counting up the number of words you have remembered correctly. Do the same with the second and third limericks.

First Limerick: When the signal is given, start memorizing the limerick below. The room will be quiet while you are learning this limerick.

There was an old man who said, "How
Shall I flee from this horrible cow?
I will sit on this stile
And continue to smile,
Which may soften the heart of that cow."

Second Limerick: At the given signal, memorize the limerick below. A phonograph or radio will be playing a musical selection while you are trying to learn.

There was an old man who said, "Hush!
I perceive a young bird in the bush!
When they said, "Is it small?"
He replied, "Not at all.
It is four times as big as the bush!

Third Limerick: At the given signal, memorize the limerick below. The teacher will make use of the phonograph or radio, buzzer, and bell, and any other noise while you are trying to learn.

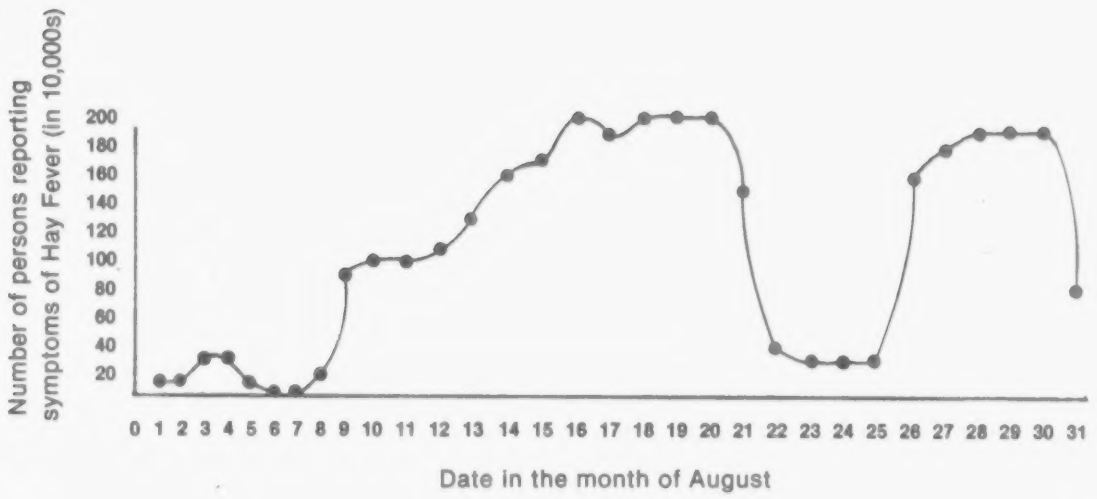
There was an old man of the Cape
Who made himself garments of crepe.
When asked, "Do they tear?"
He replied, "Here and there,
But they're perfectly splended for shape."

Summary

1. With the help of your teacher, compare your scores with those of the rest of the class.
2. How do you explain differences in results obtained in memorizing the limericks above?
3. How can the knowledge gained from this experiment be of value to you in studying at home?

Adapted from *Biology (Regents' Course)*, Board of Education of the City of New York, Brooklyn, 1962.

Appendix 6: *Hay Fever Victims*



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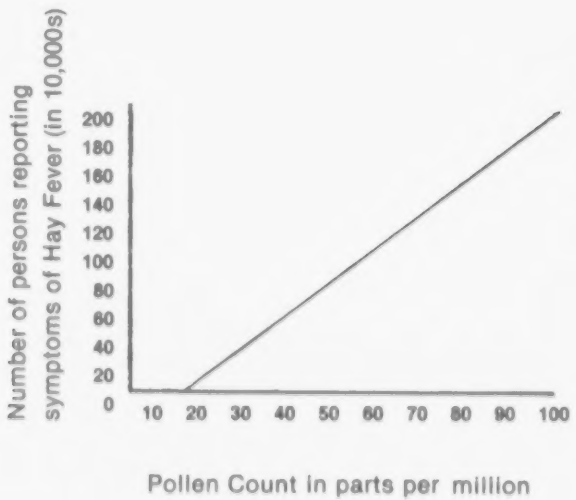

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Appendix 7: *The Ten Leading Causes of Death, 1978*

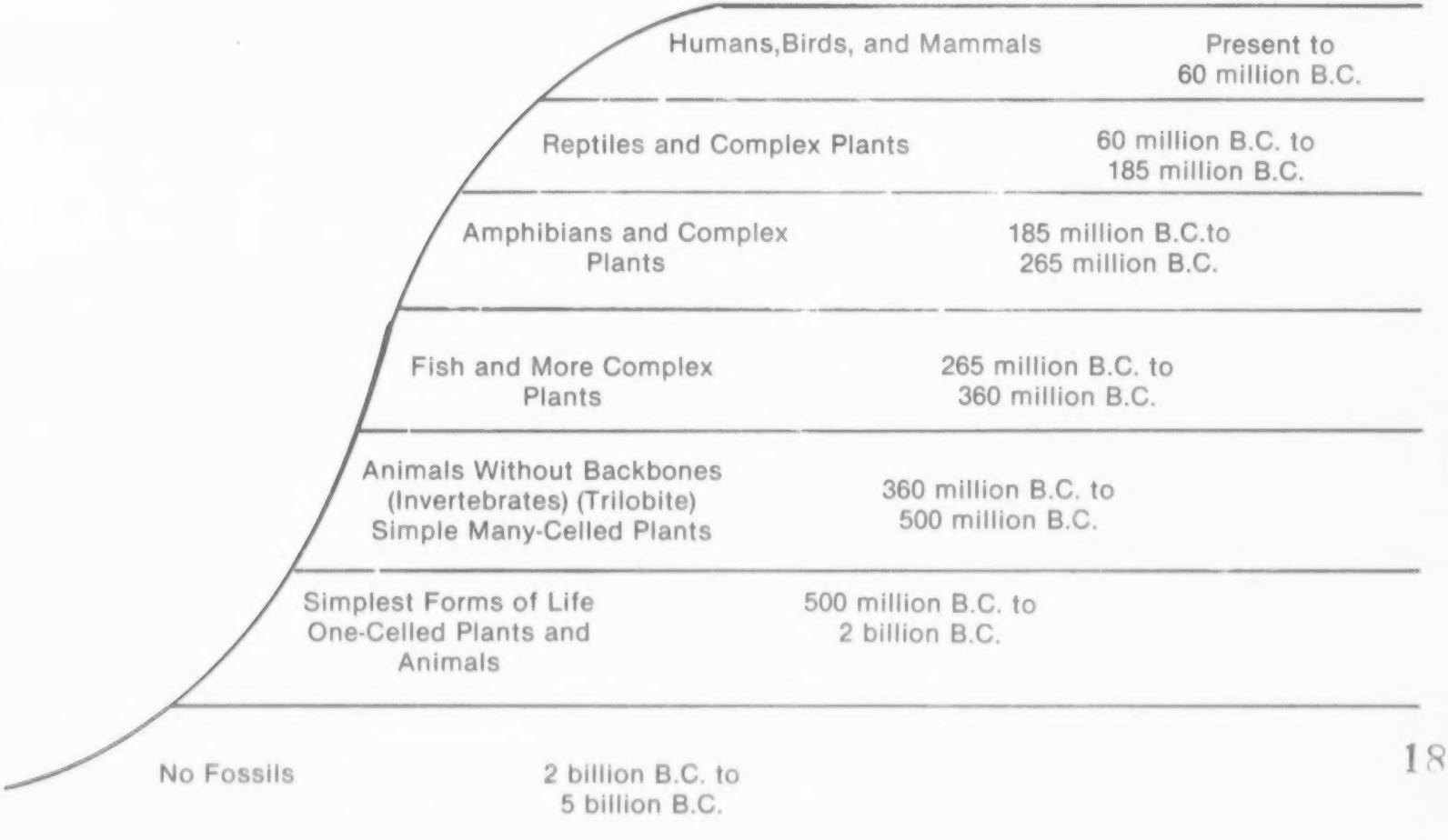
Cause of Death*	Estimated Death Rate per 100,000	% of Total
All causes	883.4	100.00
Diseases of the heart	334.3	37.8
Malignant neoplasms (cancer)	181.9	20.6
Cerebrovascular diseases	80.5	9.1
Accidents	48.4	5.5
Pneumonia and influenza	26.7	3.0
Diabetes mellitus	15.5	1.8
Cirrhosis of the liver	13.8	1.6
Arteriosclerosis	13.3	1.5
Suicide	12.5	1.4
Early infancy diseases	10.1	1.1

Source: U.S. National Center for Health Statistics, *Vital Statistics of the United States;* and unpublished data.

*These ten causes of death currently account for over 80 percent of all deaths in the U.S. Population.

Appendix 8: *Cross Section of Grand Canyon*

Showing the approximate layer in which various types of life first appeared as fossils *(Note: Some of these layers are not present in all parts of the Grand Canyon.)*


Humans,Birds, and Mammals
Present to 60 million B.C.
Reptiles and Complex Plants
60 million B.C. to 185 million B.C.
Amphibians and Complex Plants
185 million B.C.to 265 million B.C.
Fish and More Complex Plants
265 million B.C. to 360 million B.C.
Animals Without Backbones (Invertebrates) (Trilobite) Simple Many-Celled Plants
360 million B.C. to 500 million B.C.
Simplest Forms of Life One-Celled Plants and Animals
500 million B.C. to 2 billion B.C.
No Fossils
2 billion B.C. to 5 billion B.C.

Evaluation Form

HUMAN BIOLOGY CURRICULUM

Since the *Human Biology* is new and experimental, we need your suggestions and support so it can be revised into a more complete form during the 1983-84 academic year.

Please answer the questions below as completely as you can, assured that your reactions will be much appreciated and given most respectful consideration in compiling the revised edition. Please send your completed evaluations to:

Dr. Anthony A. Galitsis, Director of Science
Board of Education of the City of New York
Science Unit — Room 409
131 Livingston Street
Brooklyn, New York 11201

NAME: _____ SCHOOL: _____

SCHOOL ADDRESS: _____

NUMBER OF STUDENTS PILOTING COURSE: _____

ABILITY LEVEL OF STUDENTS: _____

1. Are the goals of this course of study clear? ☐ YES ☐ NO

   Explain: _____

2. Does this curriculum meet your students' needs? ☐ YES ☐ NO

   Explain: _____

3. Is the format of this course of study useful? ☐ YES ☐ NO

   Explain: _____

4. Is this course of study well organized? ☐ YES ☐ NO

Explain: _____

5. Would you make any changes in the types of learning activities presented in this course of study? ☐ YES ☐ NO

Explain: _____

6. Did the suggested activities enable the students to achieve the performance objectives? ☐ YES ☐ NO

Explain: _____

7. Did any of the suggested laboratory activities cause problems? ☐ YES ☐ NO

Explain: _____

8. Do you think there will be any difficulty in implementing this course? ☐ YES ☐ NO

Explain: _____

9. What additions, deletions, or changes in sequence would you recommend for each unit?

_____

10. What changes would you make to improve the quality of this document?

_____

11. Do you have any additional comments?

_____